CEREAL SCIENCE *today*

35c PER COPY

APR 3 1957
THE LIBRARY

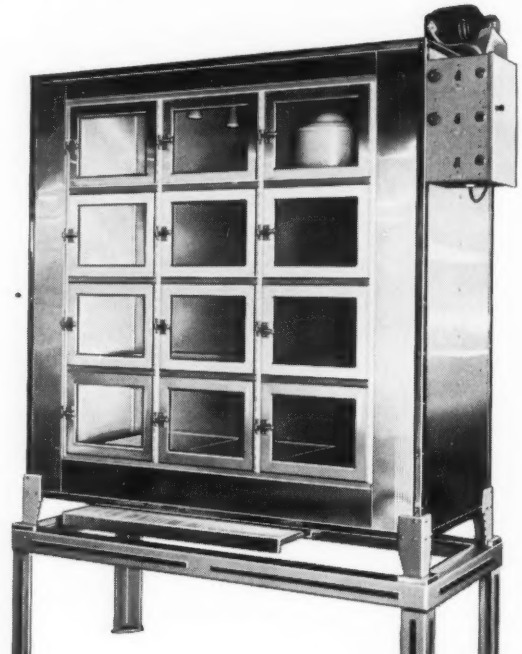
AN OFFICIAL PUBLICATION
OF THE
AMERICAN ASSOCIATION
OF CEREAL CHEMISTS

The BAILEY No. 505-SS

Fermentation Cabinet

This stainless cabinet is the successor to the Despatch Model No. 505 which has been on the market for some years. Many units of the re-designed model have been put into service in leading laboratories with very good success.

- **Walton Humidifier with constant level control**
- **Stainless Exterior**
- **Stainless Interior**
- **Stainless or brass hardware**
- **Built-in Sliding Shelf**
- **110-120V 60C A.C. Current. Maximum load 1600 watts**
- **¼ ton Refrigeration Unit Extra — $380.00**
- **Outside Cabinet Dimensions 60" x 60" x 24" deep**
- **Welded steel stand is 22" high or will build to suit. Grey shrivel finish — stainless trim Extra — $108.00**



Model No. 505-SS

Model No. 505-SS Bailey Fermentation Cabinet — $1658.00
Est. Shipping Weight 1000 lbs.
Prices F.O.B. Lincoln, Nebr.

CEREAL CHEMISTS' EQUIPMENT MANUFACTURER

NATIONAL MFG. COMPANY
LINCOLN, NEBRASKA

INSIDE SCIENCE

THE VITAL STORY OF

Breakfast Cereals

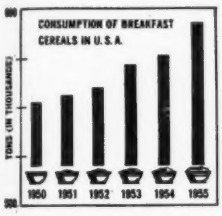
with essential vitamins and minerals restored

by Science Writer

New Edition

AMERICA LIKES BREAKFAST FOODS

Let no one doubt the popularity of breakfast cereals among Americans. The chart below traces the consumption of these fine foods between 1950 and 1955. During that period annual consumption rose by *76,000 tons.* In just one year, 1955, Americans ate 2½ lbs. of hot and 4.8 lbs. of cold cereals per person!



Why are breakfast cereals so well-liked? They are tasty; they are easily served; they appeal to busy homemakers, as well as institutional dietitians, because they are readily available in a variety of flavors at a modest cost. They add interest and value to an important but sometimes neglected meal—breakfast. Their use is extending to between-meal and party snacks, too.

Many grains are processed to make breakfast cereals: wheat, corn, oats, rice. Eaten with fruit and milk or light cream, they contribute an excellent combination of basic, flavorful, nutritious foods to the diet.

Better Foods for Better Health Through Restoration

The science of nutrition has advanced rapidly. In the manufacturing process of some cereals, some of the essential "B" vitamins and minerals are subject to some loss, just as with other foods. These losses are inescapable when such grains are prepared for human use. When this became known, manufacturers acted to overcome the losses. They adopted restoration.

Restoration simply means that certain important vitamins and minerals are restored to the cereal food during processing, so that the vitamin and mineral values in the finished product are generally equal to the whole grain values of those elements. Wheat, corn and rice products are customarily so treated. Vitamins B_1 (thiamine), B_2 (riboflavin), niacin (another "B" vitamin), and the mineral, iron, are those most widely restored. Vitamins C and D are also sometimes added.

Pre-sweetened cold cereals emphasize the nutritional importance of added vitamins. Increased calories require more "B" vitamins for best utilization of the food.

Why the Vitamins are Important

Physicians and diet experts have proved that vitamins are essential to prevent certain deficiency diseases and to contribute to robust good health.

Vitamin B_1 (thiamine) helps build and maintain physical and mental health. It is essential for normal appetite, intestinal activity, and sound nerves. A lack of this vitamin leads to beriberi, a rarity in the U. S. A., but still a very serious health problem in other parts of the world.

Vitamin B_2 (riboflavin) is essential for growth. It helps to keep body tissues healthy and to maintain proper function of the eyes.

Niacin is needed for healthy body tissues. Its use in the American diet has been largely responsible for the virtual disappearance of pellagra, a serious disease.

Vitamin D helps children develop normal teeth and bones. It prevents the development of certain abnormal bone conditions in adults.

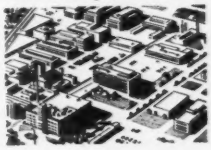
Iron is essential for making good red blood and for the prevention of nutritional anemia.

Where Do the Vitamins Come From?

At about the same time that processing losses in breakfast cereals became known, other developments in the scientific world made available ample supplies of vitamins at economical prices. Thus, the nutritional contribution of some breakfast cereals could be, and was, greatly improved through restoration.

Since the early days of breakfast food restoration and of white flour and white bread enrichment, the world-famous firm of Hoffmann-La Roche has supplied top quality vitamins *by the tons.* Pioneering work in its laboratories and by its collaborators resulted in the "duplication" of some of nature's extremely complex substances. First, the chemical composition of the vitamin was learned. Second, the pure substance was isolated. Third, the "duplicate" was made by synthesis. And fourth, the laboratory techniques were extended to large scale commercial operations.

The manufactured "duplicate" is identical chemically and in biological activity with nature's own product. A vitamin is still a vitamin regardless of whether nature or man made it. So efficient is large-scale manufacturing, that vitamins are sold at a lower cost than if they were extracted from natural sources.

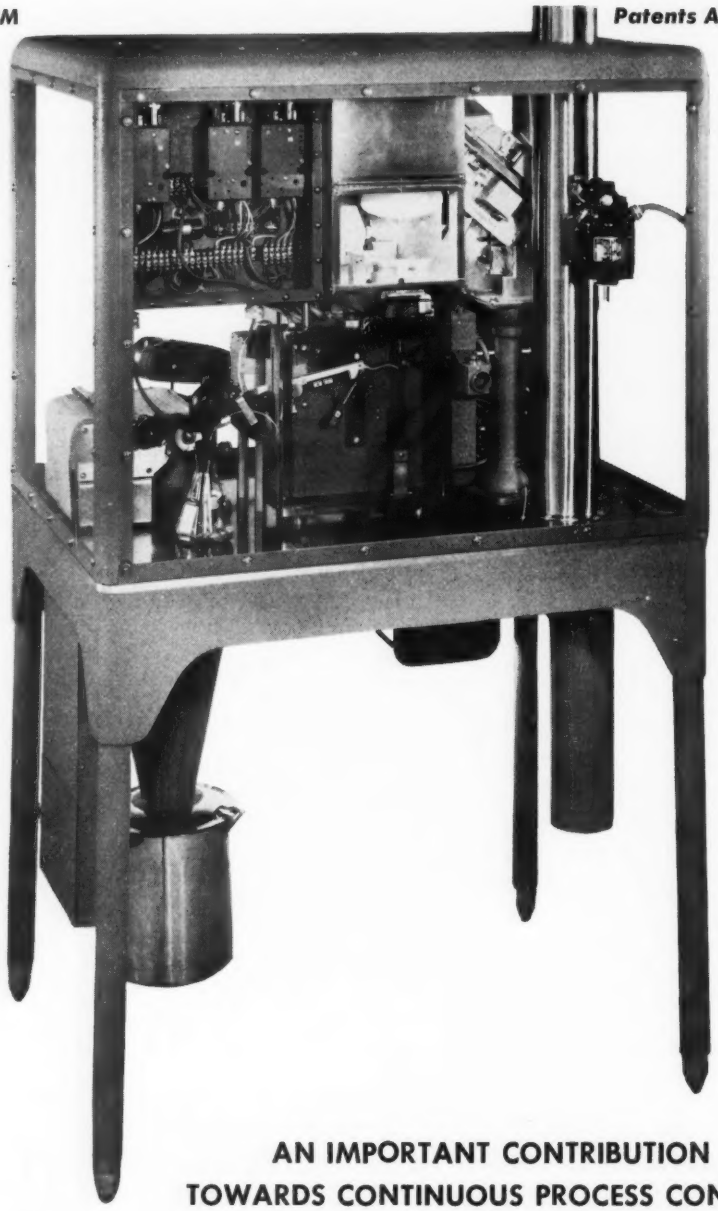


This article is one of a series devoted to the story of vitamin enriched or restored cereal products: white flour, white bread and rolls, corn meal and grits, macaroni products, white rice, breakfast cereals, farina. Reprints of this article, of any other in the series, or of all are available without charge. Please send your request to the Vitamin Division, Hoffmann-La Roche Inc., Nutley 10, New Jersey. In Canada, Hoffmann-La Roche Ltd., 286 St. Paul Street, West; Montreal, Quebec.

CONTINUOUS FULLY-AUTOMATIC ULTRA-RAPID MOISTURE RECORDER

Model CM

Patents Applied For



For Powdery or Granular Materials

ONCE EVERY 12 MINUTES A Fresh Sample of Material is Taken — Automatically — from the Moving Main Stream (or By-Pass of Main Stream) And its Moisture Content Recorded

Accurate to Within One Tenth of One Percent (plus or minus)

Moisture Content Recorded Automatically On Continuous Strip Chart and Dated Automatically

---

Provides a Record of Moisture Contents 24 Hours Each Day Seven Days a Week

AN IMPORTANT CONTRIBUTION TOWARDS CONTINUOUS PROCESS CONTROL

Manufactured in U.S.A. Exclusively by

BRABENDER CORPORATION

Established 1938

ARTHUR HARTKOPF, PRESIDENT

Tel: HUbbard 7-0214

ROCHELLE PARK, N. J.

VOLUME 2 • NUMBER 4 • APRIL 1957

CEREAL SCIENCE today

FEATURES

Wheat Development in Kansas. J. A. Shellenberger 74
A Pilot Plant for Wet-Milling. Roy A. Anderson 78
A.A.C.C.'s 42nd Annual Meeting 81

TECHNICAL

Recent Research on Oatmeal. N. L. Kent 83

DEPARTMENTS

Editorial 73
People, Products, Patter 92
Book Reviews 94
A.A.C.C. Local Sections 97
"30" 100

STAFF

PAUL RAMSTAD, Acting Editor
R. J. TARLETON, Managing Editor

C. H. BAILEY, Consulting Editor
EUNICE R. BROWN, Assistant Editor
HARLEY L. WARD, Advertising Manager
DOREEN CHRISTENSON, Circulation Manager

DEPARTMENT EDITORS
Baking Technology:
Otto G. Jensen, Oscar Skovholt
Feed and Feed Formulation:
S. F. Brockington, Loren V. Burns
Flour Milling:
R. K. Durham, H. H. Schopmeyer
Nutrition:
W. B. Bradley, Clinton L. Brooke
Sanitation:
Ross H. Cory, Kenton L. Harris
Starch and Starch Products:
Frank E. Horan, Norman Kennedy

CORRESPONDING EDITORS
AUSTRALIA: R. A. Bottomley
CANADA: L. R. Patton, H. Harms
DENMARK: Holger Jorgensen
ENGLAND: J. B. M. Coppock, C. R. Jones
FRANCE: Jean Buré
GERMANY: Paul Pelshenke
HOLLAND: G. L. Bertram
ITALY: Ottavio Chiriotti
JAPAN: Mitsuo Uemura
NORWAY: Halvor Norheim
PERU: Miguel Rafic
SPAIN: A. Quintana Mari
SWEDEN: Sven Hagberg
SWITZERLAND: L. S. Cuendet

COVER: Rows of grinding rolls in the Pillsbury Mill at Enid, Oklahoma. (Photo courtesy Pillsbury Mills, Inc.)

Copyright 1957 by the AMERICAN ASSOCIATION OF CEREAL CHEMISTS, INC.

CEREAL SCIENCE Today is published ten times per year (monthly except June and August) by the American Association of Cereal Chemists, from 500 South 5th Street, Minneapolis 15, Minnesota. Editorial Headquarters and Circulation Department: University Farm, St. Paul 1, Minn. Advertising Office: 360 N. Michigan Ave., Chicago 1, Ill. Entered as second class matter at the post office at Minneapolis, Minn., under the Act of August 24, 1912.

The American Association of Cereal Chemists assumes no responsibility for the statements and opinions advanced by contributors to its publications. Views expressed in the editorials are those of the editors and do not necessarily represent the official position of the American Association of Cereal Chemists.

Subscription rates: 1 year, $3.00; 2 years, $5.00; 3 years, $7.00. Foreign postage: $1.00 per year extra. Back issues available on request. Single copies: 35 cents.

CHANGE OF ADDRESS: Notify Circulation Department, American Association of Cereal Chemists, University Farm, St. Paul 1, Minn. Include both old and new addresses and postal zone number, if any.

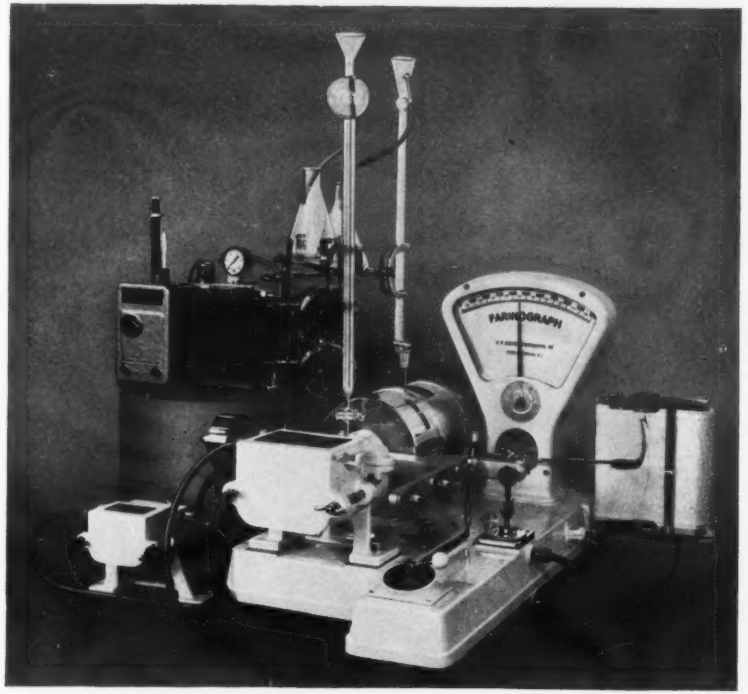
An Ideal Combination

For Rapid Wheat Testing

The C. W. Brabender Rapid Test Mill

- Produces flour samples fast enough to keep two Farinographs with 50-gram mixing bowls working continuously.

- No greater difference in Farinograms between these test mill flours and commercially milled flour than the average difference between two commercial mills grinding the same wheat.



The C. W. Brabender Farinograph

- Available with 50 or 300-gram mixing bowls, bronze or stainless steel clad with the same calibration.

Newly developed writing pens recording a whole day without refilling NOW available for all Brabender Dough Testing Machines.

Brabender

Ask for Technical Literature

C. W. BRABENDER INSTRUMENTS, Inc.

SOUTH HACKENSACK, NEW JERSEY

Exclusively franchised Sales and Service Agents for the Milling Industry.
MIAG NORTHAMERICA, Inc.
1010 South 5th Street

Editorial

MILLING AND BAKING developed as arts over a period longer than recorded history. The relatively recent introduction of scientific methods into these and other cereal processing operations has resulted in the development of a technology that has brought great changes, with more on the way. An important difference between an art and a science is the wide use of measurements and measurement techniques in science.

Researchers seeking new knowledge, technologists developing new products and processes, technicians controlling process conditions and product quality, all spend a large share of their time making measurements of one kind or another. People with technical backgrounds are frequently sought for positions outside the laboratory because they understand the use of measurement data in making decisions.

Progress in areas of both pure and applied science is largely determined by the rate at which new measuring methods are developed, refined, and applied to particular problems. A major breakthrough in measurement of an important variable frequently precedes an era of rapid development in a technological field.

Cereal scientists are no less concerned with measurements and their interpretation than their contemporaries in other fields of technology. Some of their measurements are chemical analyses; others are physical tests; some do not fit in either of these classifications. Increasing attention is being given to the cost of making a measurement versus its value in controlling a process or making a decision. The optimum or desired value for some variables depends upon economic or psychological factors. Again measurements, but of a different kind, enter the picture.

With more factors that can be measured and more methods of measuring them, the question of what to measure and how to do it becomes more challenging. There is a tendency to make a determination just because it's easy and to omit one that is more important but more difficult. Selection of the best method to use in measuring a particular variable depends upon many considerations, of which precision is only one. Sampling method, sample size, time required from beginning to end of determination, actual labor required per determination, special equipment needed, training required of the operator, and, of course, the purpose for which the data are desired are all important considerations. The method of choice under one set of circumstances may not be the best in another situation.

Perhaps the trend toward greater speed and more instrumentation will lead to some measurements now made in the cereal laboratory being made automatically right on the production line. This is already being done in some industrial processes. Scientists often find methods adaptable to their use in fields quite unrelated to their own. The challenge presented by the need for more, better, and faster measurements is as interesting as any problem cereal scientists face today.

PAUL E. RAMSTAD

THE STORY OF

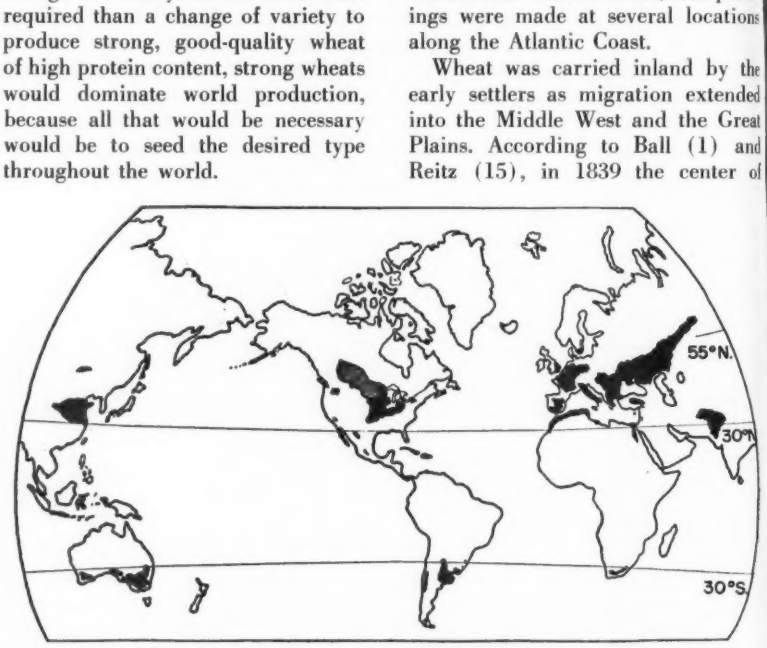
Wheat Development in Kansas

By J. A. Shellenberger*

EVIDENCE EXISTS THAT wheat has been cultivated for at least 6,000 years (14). The spread of wheat production throughout the world during this period provides ample opportunity for study and speculation regarding the influences on wheat of soil, climate, and genetic change. There has developed, first by means of natural selection and later by application of scientific plant breeding methods, a large assortment of wheat types. The wheat plant has wide adaptation. In the Northern Hemisphere its range extends beyond 60° North Latitude, and in the Southern Hemisphere beyond the parallel of 40° South in New Zealand, Argentina, and Chile. Wheat production encircles the entire earth, as is shown in the world map, but the major producing areas lie between the parallels of 30° and 55° North and between 30° and 40° South Latitude.

Areas of Strong Wheat Production

Considering the large world area where wheat is grown (see map), it is surprising that the areas of strong wheat are confined to relatively small regions in North America and Europe. Prevailing world opinion, and to a considerable extent domestic opinion also, is that only the spring wheat region of North America can qualify consistently as a producer of exceptionally strong hard wheat. Some areas, such as parts of the Balkans in Europe once well known for the quality of their wheat, are no longer producing wheat of the same reputation. Also pertinent is the fact that no area known for strong wheat production, once it has lost that reputation, has ever regained it. Obviously, the production of good strong wheat involves more than merely a change of variety. If no more were required than a change of variety to produce strong, good-quality wheat of high protein content, strong wheats would dominate world production, because all that would be necessary would be to seed the desired type throughout the world.



Major wheat-production areas of the world. Strong wheat production area is crosshatched.

Wheat History in the United States

These considerations of wheat quality in the world lend interest to the study of wheat production in the United States, particularly in the Southwest, and are the basis for the opinions now held regarding the baking quality of Southwestern wheat. Carrier (4), Buller (3), and Ball (1) have described the early history of wheat growing and wheat improvement in the United States and Canada. According to Dondlinger (5), the first wheat planted in this country was on one of the Elizabeth Islands off the southern coast of Massachusetts in 1602. Explorers and settlers from various European countries brought different varieties of wheat to this continent at various times, and plantings were made at several locations along the Atlantic Coast.

Wheat was carried inland by the early settlers as migration extended into the Middle West and the Great Plains. According to Ball (1) and Reitz (15), in 1839 the center of wheat production was in Pennsylvania, but by 1869 it had moved west to central Indiana. This was about the time that wheat production on a large scale began in the Southwest, and the statements in the following paragraph give briefly the sequence of events which occurred.

What the Southwest was like before white men came can be judged best by reference to the observations of Lewis and Clark in 1808. According to Bracke (2), these explorers on their trip up the Missouri river were impressed with the great expanse of

* Head, Department of Flour and Feed Milling Industries, Kansas Agricultural Experiment Station, Manhattan, Kansas. Contribution No. 276 of the Department of Flour and Feed Milling Industries.

grasslands and the large number of buffalo, deer, and wild turkeys they saw. Lieutenant Z. M. Pike, whose exploring party traveled overland a few years later, failed to appreciate the potentiality of the area he crossed. He wrote that the prairies were "impossible of cultivation." Even Washton Irving was unimpressed and wrote in his "Tour on the Prairies" (8), referring to the Southwest, "It could be well named the Great American Desert. It is a land where no white man permanently abides, for in certain seasons of the year there is no food for hunter or his steed." Horace Greeley (7), who traversed the area in 1859, had some caustic comments at the time regarding the country, but he was also impressed with the beauty of the area. He described the territory in and around Johnson County in east-central Kansas, as "high prairies sloped as gently and grassed as richly as could be desired, with timber visible along the water courses on either hand." He added, "If the Garden of Eden exceeded this land in beauty or fertility, pity Adam for having to leave it."

Settlers did come to the Southwest, and according to Bracke (2) the first wheat, brought from Illinois, was planted in Kansas in 1855 and harvested in 1856. Some of this wheat was reseeded that same season, but that crop was poor. Malin (12) reports that there was a wheat crop failure in the area in 1860. Drought continued to plague the farmers, as did the realization that the climate of the area was basically different from that of the humid East from whence the settlers had come. Winter killing, too, was one of the most important hazards. It began to be recognized that several conditions such as time and method of planting, tillage practice, moisture, and wind erosion, as well as varieties play a part in this problem of growing wheat. Generally the farmers realized that to face the climatic hazard of the Southwest they needed drought-resistant wheat adapted to the prairie environment.

Introduction of Wheat into Kansas

Fortunately for the development of hard wheat in the Southwest, conditions in Russia about this time became unsatisfactory for a group of Mennonites who had migrated from Prussia to Russia and settled in an area north of the Black Sea during the reign of Catherine the Great. Later, the special privilege which the Mennonites had received relative to military service was revoked. Migration to the United States began and the first of the Mennonites to arrive started wheat farming in Kansas in 1873.

Environmental conditions which the Mennonites had encountered in Russia were similar in many respects to what they found in Kansas. They brought with them the type of hard winter wheat that had been grown successfully in their former farming region, which was similar in character to that of Russia. From their experiences in Russia they learned the value of conserving soil moisture, the importance of cultivating at the right time, and the merits of summer fallow. The farming methods of the Mennonites and their strong, hardy winter wheat marked a new era of wheat production in the United States —the era of Turkey-type wheat. At first, however, the new hard wheat was not well received; the millers complained of its hardness, and housewives were prejudiced because they liked the easier-handling soft-wheat flour to which they were accustomed. Even the bakers objected to the so-called "flinty gluten." Nevertheless, hard winter wheat soon held a preeminent position.

Hard Wheat Flour

At the time when Turkey-type wheat became established, several unusually favorable conditions were present. The virgin, highly fertile prairie was being planted for the first time to a type of hard wheat not previously grown on this continent. This hard wheat was milled into flour and shipped to areas of denser population in the East. Hard-wheat flours of relatively high protein were unknown in the market at that period, but fortunately the arrival of this new type flour coincided with the rapid transformation from home baking to commercial baking, or acceptance would have been far less favorable. According to Kyrk (10), the American baking industry in this period showed phenomenal growth, far exceeding that of population; its per-capita output increased tenfold from 1860 to 1919, with most rapid expansion between 1880 and 1890.

In recent years the feeling has seemed to prevail that wheat production in the Southwest has fallen from the pedestal on which it once rested. If true, the reason for this opinion should be sought and analyzed, and remedies should be developed. Most critics seem to be of the opinion that a change in the type of wheat varieties grown is a remedy to the situation. The view is, apparently, that since a change from soft to hard wheat produced a phenomenal improvement in quality in 1873, another change would now bring as great an improvement. Salmon *et al.* (16) and Reitz (15) have fully described the great contribution which improvement in wheat varieties has brought about in the United States. It is not likely, however, that another such striking improvement in quality is imminent as that which occurred following the introduction of Turkey-type wheat. The habits and qualities of the wheats grown over the world are at present well known. There is no longer the same opportunity to bring into a new land wheat of a new type for a new market. All indications are that improvement in wheat production and wheat quality in the future will come through research and much hard work, and at a much slower pace than that which occurred when the Southwest switched from soft to hard winter wheats.

Wheat Varieties

Actually the merits of Turkey-type wheat are often greatly exaggerated, just as "the bread that mother used to make" could never have been so good as reported. At the Kansas Agricultural Experiment Station (17), Turkey wheat is regularly planted at a dozen or more fields and branch stations and under comparable conditions next to other varieties. Aside from the fact that on the average the farmer would suffer a yield loss of approximately 9 bushels per acre, and a test weight loss roughly comparable to a reduction of one grade on the market, the strength of Turkey wheat for bread baking is inferior to, or no better than, that of several other varieties grown today which have Turkey parentage.

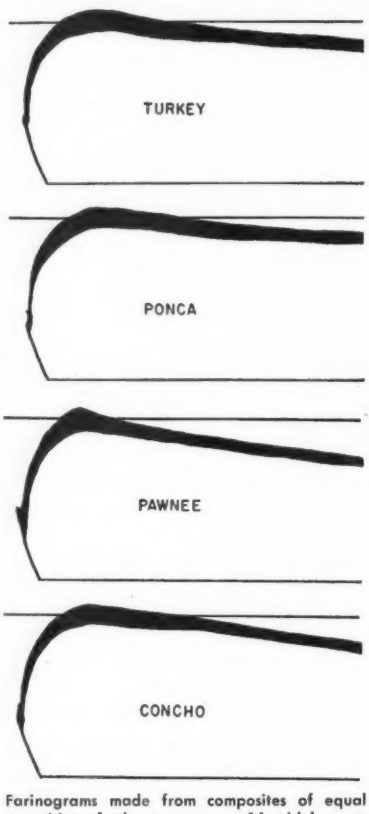
The properties of four varieties from the 1955 Kansas wheat crop are compared in the farinograms and in Table I. Within the state of Kansas in 1955, the protein content of the same wheat variety, grown from the same seed but at different locations,

varies from about 9.5% to 17.0%. Other properties vary similarly. For example, the average valorimeter value of the farinograph curve for Ponca is 58, although the individual values, depending upon location, range from 38 to 77. Inspection of the four farinograms and Table I shows that, contrary to popular belief, Turkey does not possess properties which are not inherent in other wheat varieties. Turkey was for a number of years the dominant hard wheat grown in Kansas, but the needs of the farmer would be less satisfactorily served, and it is questionable if the needs of the miller and baker would be more satisfactorily served, if Turkey were the dominant variety in the Southwest at the present time. Turkey parentage is in all the commercially important wheat varieties grown in the Southwest. The wheat acreage seeded in Kansas for the 1956 harvest was distributed among the following varieties, all of Turkey parentage: Wichita 21%; Pawnee 18%; Kiowa 16%; Comanche 15%; and Ponca 13% (9).

Table I. Comparison of the Properties of Four Wheat Varieties Grown at 16 Stations in Kansas in 1955 [a]

Variety	*Protein*	*Protein Range*	*Valorimeter Value*	*Farinograph Absorption*	*Sedimentation Value*	*Loaf Volume*
	%	%		%		cc.
Concho	13.6	9.2-17.2	55	69.9	43	806
Pawnee	13.9	9.4-17.1	50	69.0	40	805
Ponca	14.0	9.7-17.1	58	67.6	46	839
Turkey	13.6	9.4-15.8	55	66.4	45	819

[a] Values reported are the means from 16 samples.



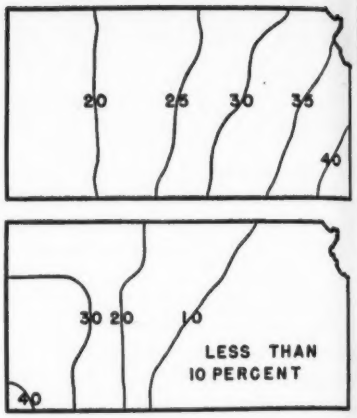
Farinograms made from composites of equal quantities of wheat grown at 16 widely scattered stations in Kansas in 1955.

The introduction of a new wheat type into Kansas in 1873 has made a tremendous impact on popular fancy. From time to time a similar miracle is expected—the introduction or development of a new wheat variety which will bring to an end the problems associated with the manufacture of hard-wheat flour for commercial bakery use. This dream is not likely to be realized, because improvement is coming about continuously through scientific advances in wheat breeding and evaluation, and therefore progress, though gradual, is steady.

Environment and Soil

The influence of environment and soil on the quality characteristics of wheat is often overlooked when reasons for quality changes are sought. Generalizations are made regarding wheat production areas such as the state of Kansas — as if climate and soil were uniform over a physical division of land such as a state, and consequently could provide a uniform environment for the wheat plant throughout the area in a given year and also from season to season. The state of Kansas is a good example of how wrong this concept can be.

Rainfall decreases uniformly from east to west across Kansas, as illustrated in the first map. In the eastern part of the state, precipitation is over 40 inches per year; in the western tier of counties it is about 11 inches. In fact there has been about 40% abandonment of wheat acreage, on the average, during the past 50 years in counties near the Colorado boundary. Most of the abandonment has been due to lack of moisture, as inspection of the two state maps will show.



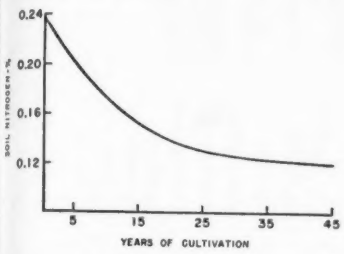
Upper map of Kansas shows normal annual precipitation. The range is from over 40 inches in the southeast to considerably less than 20 inches in the extreme west. Lower map indicates abandonment of winter wheat in Kansas; average percent of acres abandoned during the period 1916-1952.

Such a wide variation of moisture conditions obviously will cause wheat to vary in strength and baking quality as well as in test weight and yield throughout the state. Variations in rainfall also have a profound influence on soil fertility and soil texture. A combination of circumstances sometimes can result in the production of less satisfactory wheat than is customary. When this happens, it is a serious misfortune to the area. Some day, through research, there will come a full explanation of the reasons for variations in the quality of wheat. For the present, however, it is well to realize that a new wheat variety introduced into the Southwest, or the return to the growing of Turkey wheat, would not necessarily provide a full remedy.

Soil Nitrogen

At the time when wheat production in Kansas first became important, the crop was planted in virgin soil. Records of soil nitrogen depletion at the Fort Hays Branch Station (13) and at other Kansas stations covering the past 45 years show how rapidly the originally high nitrogen content of the soil has been depleted. In less than 50 years soil nitrogen has been reduced one-half, as indicated in the accompanying graph. At the present time, except in areas of extremely high yields, it is not economical to add fertilizer to wheat. Neither is it possible in the major wheat production areas of the Southwest to grow

Effect of years of wheat cultivation on the soil nitrogen content at the Hays Branch Experiment Station in Kansas.



legumes, except under irrigation, to help replace the depleted soil nitrogen.

Improvement of wheat varieties has done much to produce higher yields for the farmer. This blessing in terms of farm income is also a factor in the production of wheat of lower protein content, because the available amount of nitrogen in an area of soil during the growing period is somewhat fixed by environmental conditions. Generally when yields are high, the available nitrogen is shared by more wheat kernels, and consequently, the amount of nitrogen per kernel is less than if the yield had been lower. High yields usually mean wheats with less protein.

The manner in which climate affects the quality of wheat is not fully understood, but everywhere it is recognized that some areas are suitable for wheat production and some are not. The best conditions for wheat production are warm summers and subhumid or semiarid climates, and rich, deep, black or brown soils. The combination of high temperatures and high humidities is most detrimental to successful wheat production. It is for this reason that, although wheat can be grown in a wide range of climate and soil types, only a few areas regularly produce strong, high-gluten wheats.

Effect of Climate

As a rule, climatic conditions are critically variable during the growing season in regions of winter wheat production. This condition helps to account for the fact that hard spring wheats, in contrast to winter wheats, are usually stronger and vary less in quality from year to year. In the Southwest, winter wheat is usually harvested before the peak of summer high temperatures arrives. However, the extent of high temperatures, hot winds, and low humidities at certain stages in the development of the kernel has been shown by Finney (6) to be extremely detrimental to the baking quality of wheat under certain conditions. On the basis of present knowledge the evidence indicates that changing wheat varieties would not alter significantly the detrimental influence of adverse environmental conditions. When environmental conditions are adverse to the production of wheats with good gluten, the solution does not necessarily lie in the relatively simple procedure of changing varieties.

Expectations

What does the future hold in store? There will, of course, continue to be improved wheat varieties. Perhaps in time the wheat plant can be modified to become a more efficient provider of nitrogen. Since nitrogen is plentiful in the earth's atmosphere, the problem is to make it available to the wheat plant for conversion into gluten proteins. Until methods are developed that will make the wheat plant produce kernels having higher protein of better strength, perhaps it would be advisable for users of hard-wheat flours to become more realistic regarding their quality expectations.

There are many valid reasons why certain flour standards are established, and no one can deny the merit of a tolerance range, particularly for modern high-speed baking operations. However, hardly anyone associated with the baking industry contends that the requirements which have been established in recent years reflect the necessary requirements of the baking industry. Flour specifications, often for the production of the same baked product, vary over a wide range, and therefore it can be argued that the flour must not influence the final product greatly, although in using different flours to produce the same product, production changes conceivably would be required. The farmer, miller, baker, and consumer can all be better served by the full realization that there is no known way at present to produce a uniform wheat, either in yield, test weight, grade, physical and chemical properties, or milling or baking quality. When this is accomplished, man will have learned to exercise some control over environment and soil conditions. A wheat breeding program alone is not enough.

Larmour (11) prepared a good resume of the effect of environment on wheat quality.

Conclusions

Wheat quality to the greatest extent is the work of nature in which man's principal contribution, at this stage of our knowledge, is that of developing new varieties. Wheat varieties can be successful, however, only in good baking quality of the flour produced from it, when soil conditions and environment permit it to mature under satisfactory conditions.

Variety changes have attracted much publicity and have tended to focus attention away from other equally important influences on wheat quality. Too little attention has been paid to the decline in soil fertility in the wheat-producing area, and the concept of wheat evaluation for quality has undergone change. Hard winter wheat-producing areas are subject to great extremes of environmental conditions, and this situation causes profound quality changes from year to year. The consistent production of strong, good-quality, high-protein wheat is dependent upon the proper balance of the influences of environment, variety, and soil.

The author is indebted to Doctors H. H. Laude, E. G. Heyne, and J. A. Hobbs of the Department of Agronomy, Kansas Agricultural Experiment Station, and to Dr. L. P. Reitz, Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, for helpful information, advice, and criticisms. Thanks are also due other colleagues at Kansas State College and Ruth Emerson, Librarian, American Institute of Baking, for assistance in preparing this article.

Literature Cited

1. Ball, C. R., Leighty, C. E., Stine, O. C., and Baker, O. E. Wheat production and marketing, U. S. Dept. Agr., *Yearbook*, pp. 77–160 (1921).
2. Bracke, W. B. Wheat country. Duell, Sloan, Pearce: New York (1950).
3. Buller, A. H. R. Essays on wheat. MacMillan: New York (1919).
4. Carrier, L. The beginnings of agriculture in America. McGraw-Hill: New York (1923).
5. Dondlinger, P. T. The book of wheat. Orange Judd Co.: New York and London (1910).
6. Finney, K. F. Contributions of the hard winter wheat quality laboratory to wheat quality research. *Trans. Am. Assoc. Cereal Chemists 12:* 127–142 (1954).
7. Greeley, H. An overland journey from New York to San Francisco in the summer of 1859. Saxton, Barker & Co., New York, H. H. Bancroft & Co.: San Francisco (1860).
8. Irving, W. A tour on the prairies. The Crayon Miscellany: New York (1869).
9. Kansas State Board of Agriculture, Division of Statistics. Kansas wheat variety survey, 1956. Topeka, Kansas (April 18, 1956).

(Please turn to page 96)

TO AID IN THE STUDY OF CEREAL GRAINS:

A Pilot Plant For Wet-Milling

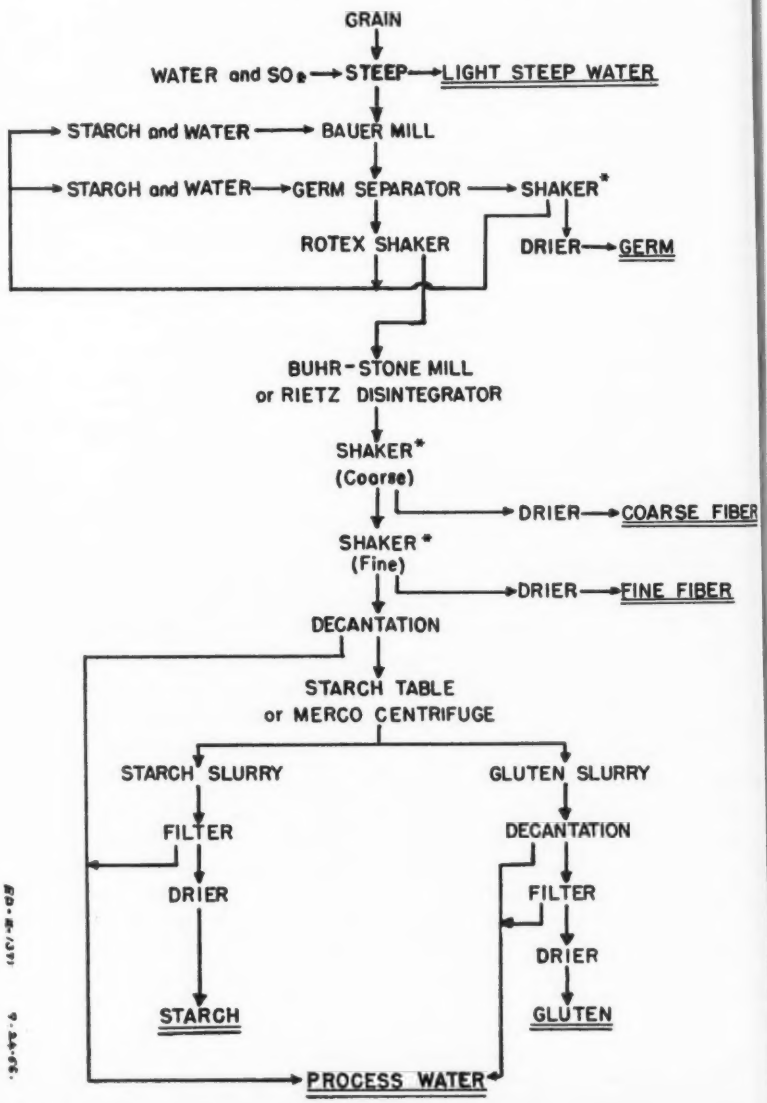
By Roy A. Anderson*

THE ESTABLISHMENT OF a new industrial plant always presents special problems to the chemical engineer. He must make a choice of processing methods, and also of equipment with which to carry them out. He naturally wishes to incorporate into the plant new or improved methods to simplify the process and to effect working economy. Whether the product is to be made from petroleum, steel, or grain, the engineer must have much specific information before the plant can be designed. He must thoroughly investigate the process in a pilot plant, to find data from which he can ascertain the technical possibilities of the process and the prospects for its economical operation.

Investigations on the utilization of cereal grains for food and feed and in industry have been made and are continuing at the Northern Utilization Research Branch: wet-milling studies on wheat; on corn of many varieties, including waxy and high-amylose; on grain sorghum, both waxy and nonwaxy; on barley, also waxy and nonwaxy; and on oats and rye. Such studies involve developmental work on a pilot-plant scale. To carry out a portion of this work, a pilot plant has been constructed for studying the problems involved in the wet-milling of cereal grains for the production of starch and gluten.

Wet-Milling of Corn

Corn and grain sorghum are the only grains being commercially wet-milled today. In the industrial production of starch from corn, the corn is first steeped in a sulfurous acid solution to swell and soften it. The sulfurous acid concentration of the steep is increased as the steeping process progresses; this is termed counter current steeping. The corn is then



General flowsheet of pilot-plant wet-milling procedure. Fresh water is used for washing on the shakers. The washings are carried along with the mill starch; and excess water is removed by decantation prior to starch-gluten separation.

* Northern Utilization Research Branch, Peoria, Illinois, one of the branches of the Agricultural Research Service, U. S. Department of Agriculture. This article is a contribution from the Northern Utilization Research Branch.

crushed to free the germ; the germs are floated off by gravity separation; and the germ-free mass is ground to a fine pulp in stone mills, which rub the starch and gluten from the bran or fiber. The starch-and-gluten mixture, in water suspension, is then sieved from the fibers and is known as mill starch. This slurry is pumped to tables or centrifuges where the starch is separated by gravity from the gluten. The starch may then be dried; or modified and dried to make various types of dry starches; or it may be hydrolyzed with acid to produce corn sirup or corn sugar. Gluten may be used for the production of zein or monosodium glutamate, or added to other by-products to make corn gluten meal or feed. Oil is extracted from the germ by expellers or by solvent extraction. Corn oil cake is used in the feeds, either alone or mixed with other by-products.

Every cereal grain can be wet-milled by modifications in equipment or processing (4). The pilot plant which will be described can be adapted so that experimentation can be carried out with any of the cereal grains. This pilot plant has been used to study the wet milling of grain sorghum grits (1). A number of years ago, a thorough study of the problems involved in the wet-milling of wheat was carried out in a similar pilot plant (3). More recently, some preliminary tests have been conducted on the pilot-plant preparation of starch from high-amylose corn.

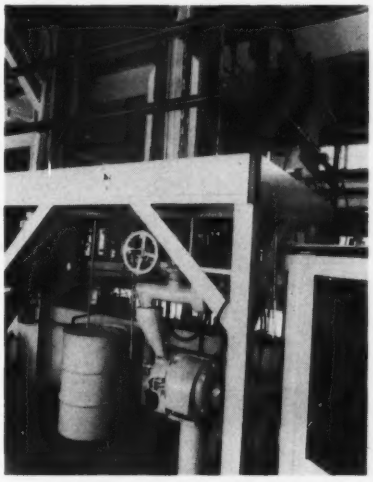
Pilot-Plant Operation — Steeping

The pilot plant has a capacity of 4 bushels of grain, and is batch-wise in operation. It is constructed completely of stainless steel, type 316, which is resistant to the corrosive action of sulfurous acid. The accompanying flowsheet explains the procedure.

The grain is soaked or steeped in warm water in a conical-bottomed tank for the required time. Steepwater is drawn continuously from the bottom of the tank, circulated by a pump through a heat exchanger, and then passed back over the grain. The temperature of the water is controlled by a pneumatic controller. If desired, sulfur dioxide can be bubbled into the steepwater. Countercurrent steeping can be simulated by proper control of the added gas. In commercial practice, the major function of the sulfur dioxide is to disintegrate the proteinaceous matrix in which the starch granules lie embedded in the kernel, thereby facilitating the separation of the starch from protein (2). The sulfur dioxide also serves to inhibit the growth of undesirable microorganisms.

Grinding and Separating

After the steeping is completed, the steepwater is withdrawn. The softened grain is fed by a screw conveyor to an 8-in. Bauer mill[1] for the first grinding. This mill is a single-running disk grinder which can be fitted with a variety of plates. The first photograph shows the steep tank, feeder, and Bauer mill.



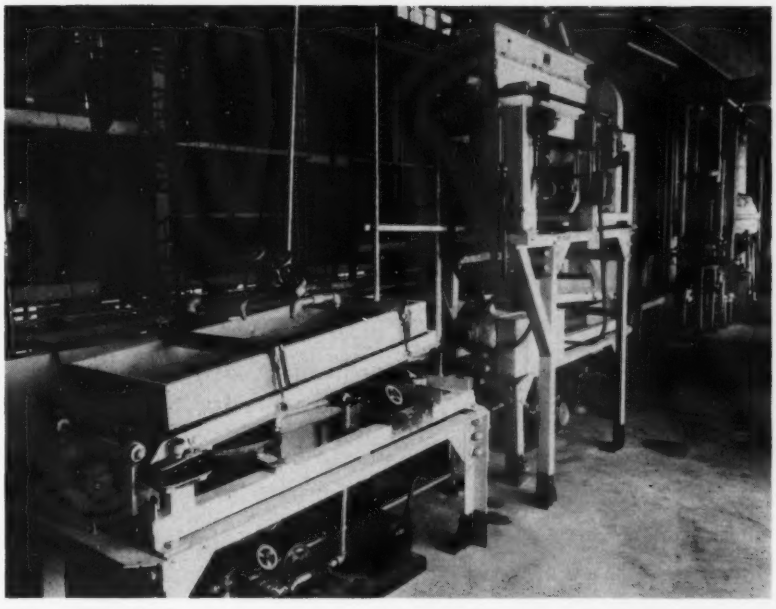
Steeping equipment and grinder.

If germ recovery is desired, the ground material is fed to a germ separator. Here the germs are floated off from the starch slurry, screened, washed on a Rotex gyratory shaker equipped with a 60-mesh screen, and dried. The next photograph shows the separator and shaker used in this process.

The underflow from the germ separator, consisting of fibers, starch, and gluten, is dewatered on the Rotex shaker, equipped with a 200-mesh screen, and then passed through either a buhr-stone mill or a Rietz disintegrator for the second grind. The buhr-stone mill is a single-runner type with 12-inch stones. The Rietz disintegrator is a vertical attrition mill with rotor turning at 3600 r.p.m. The rotor, fitted with seven sets of fixed hammers, is completely surrounded by a screen. On our scale of operation, the mills do equally well on this grind, although the Rietz machine has a much greater capacity than the buhr-mill. The mills are pitcured in the next cut.

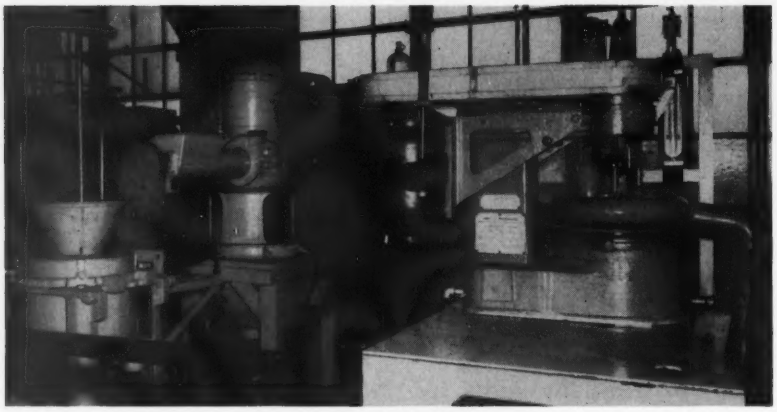
After the second grind, the material is passed over the Rotex shaker equipped with a 26-mesh screen for recovery of the coarse fibers, which are washed and dried. The underflow from this separation is passed over the shaker, equipped with a 200-mesh screen, for the recovery of the fine fibers which are also washed and dried.

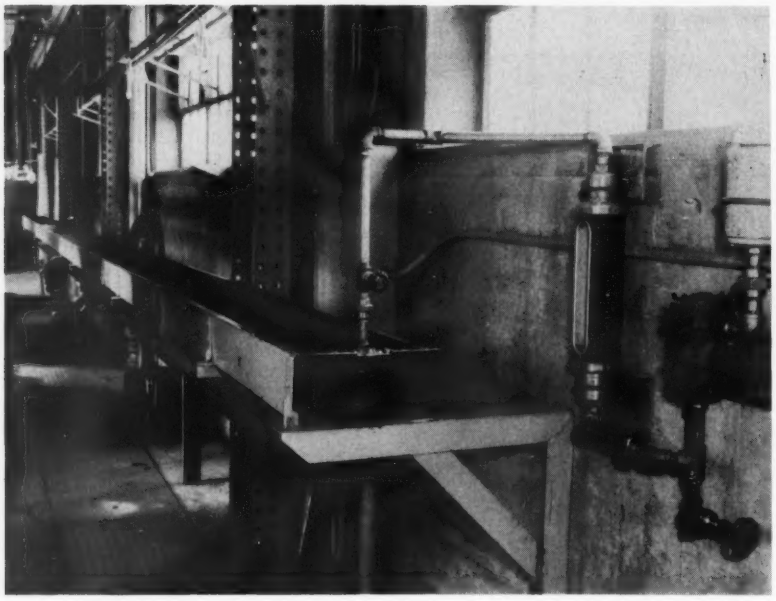
Germ separator and shakers.



The material remaining after the

[1] The mention in this article of firm names or commercial products under proprietary names or names of their manufacturers does not constitute an endorsement by the U.S. Department of Agriculture of such firms or products.





Top: Grinding mills and Merco centrifuge.
Bottom: Starch table and accessories.

fibers and germ are recovered is called mill starch, and is made up of the starch and the gluten. It is necessary to adjust the specific gravity of the slurry before these two materials can be separated by either tabling or centrifugation. This is accomplished by adjusting the ratio of solids to water. The pilot plant is equipped with a Merco B-9 centrifuge, a specially designed nozzle-discharge centrifuge that is capable of handling solids in suspension and washing them as they are being concentrated. The pilot-plant starch table is 46 feet long and 12 inches wide and has a pitch of 2½ inches for its entire length. The starch table with its accessories is shown in the last photograph; the centrifuge in the previous one.

The starch and gluten fractions are filtered and dried.

Facilities are available for evaporating the steepwater and preparing by-product feeds. Equipment is available also for conversion of starch to glucose sirup and for the crystallization of glucose sirup to produce dextrose sugar.

A rather complete study of the many operations and numerous variables encountered in the wet-milling of cereal grains is possible with this versatile pilot plant. The data obtained from such a study provides information so that estimates of investment and operating costs can be prepared for the entire process, and the design of a plant is possible.

Literature Cited

1. Anderson, R. A. *Trans. Am. Assoc. Cereal Chemists 13:* 241–248 (1955).
2. Cox, Mary J., MacMasters, Majel M., and Hilbert, G. E. *Cereal Chem. 21:* 447–465 (1944).
3. Slotter, R. L., and Langford, C. T. *Ind. Eng. Chem. 36:* 404 (1944).
4. Zipf, R. L. Wet milling of cereal grains. U.S. Dept. Agr., *Yearbook.* Washington, D.C. (1950–51).

COMING NEXT MONTH

Canada's Grain Research Laboratory by J. A. Anderson and T. R. Aitken, Board of Grain Commissioners for Canada, Winnipeg

Separation of Feed Ingredients by Selective Flotation by Betty Kidwell, Ralston Purina Co., St. Louis.

Some Effects of Gamma Irradiation on the Biochemical, Storage, and Breadmaking Properties of Wheat by Max Milner, Kansas State College, Manhattan

Studies on Variance in Buhler Mills, with a Bibliography on Experimental Milling by W. J. Eva, The Ogilvie Flour Mills Co., Winnipeg

An outstanding technical program, a convention city of unusual charm and color, and a schedule of interesting social arrangements mark the AACC's

42nd Annual Meeting

AN IMPRESSIVE PRELIMINARY program, highlighting events and important technical papers, has been announced for the 42nd Annual Meeting of the American Association of Cereal Chemists. Gathering on the west coast for the first time in its history, the Association will meet in the Sheraton-Palace Hotel located in the tourist center of San Francisco.

This meeting will be especially memorable for a presentation of the THOMAS BURR OSBORNE Medal to Canada's distinguished cereal scientist, Dr. J. A. Anderson. Founded by the A.A.C.C. in 1926 to recognize "distinguished contributors in the field of Cereal Chemistry," the award was named after one of the world's outstanding protein chemists. It has been awarded only nine times previously during the 31 years of its existence.

The Association is fortunate in having secured eminently well-qualified guest speakers to discuss four topics of vital interest to its members. These speakers are Dr. Karl Brandt, Associate Director, Food Research Institute, Stanford University; Mr. Charles W. Crawford, former head of the Food and Drug Administration, now retired; Dr. Laurance W. Kinsell, Director of the Institute for Metabolic Research, Highland Hospital, Oakland, California; and Mr. Robert B. Taylor, Administrator of the Oregon Wheat Commission, Pendleton, Oregon.

Dr. Brandt will address the Association on "Dynamic Shifts in the American Cereal Economy." He will deal with the changing role of cereals in the modern economy with an expanding population and rising income per capita. Shifts in human consumption and shifts in domestic production and utilization with improved efficiency of conversion will be surveyed relative to the changing scene of the parity policy, price supports, and subsidized exports.

Mr. Crawford will speak on "The Fight for Pure Foods and Drugs." In Mr. Crawford's view, the long and historic struggle for better, safer, purer foods and drugs is not yet won; grave problems still confront Food and Drug Administration officials. Although the grosser forms of adulteration and contamination have been curbed, more subtle forms occur and are devised, providing problems of more sophisticated and difficult nature. So long as a fringe exists of operators who do not hesitate to take advantage of the consuming public, difficulties will be encountered in fulfilling the basic purpose of the laws.

Dr. Kinsell's topic will be "Essential Fatty Acids, Lipid Metabolism and Vascular Disease." There is much general interest in this field at the present time, but cereal chemists have a particular interest because a major market for fats and oils is provided by the baking industry. Dr. Kinsell will point out that prior to 1950 the place of fat in human nutrition had received little attention except in terms of calorie equivalents, and in terms of possible unfavorable relationship to the production and progression of atherosclerosis. The small amount of published work which had been designed to evaluate differentially the effects of animal and vegetable fat indicated that "fats were fats" and implied that, generally speaking, they were all "bad" insofar as vascular disease was concerned.

Work carried out in Dr. Kinsell's laboratory since 1950, and confirmed since 1953 by many workers, has shown that major differences exist between fats from different sources. In essence, fats which contain an abundant amount of linoleic acid produce a significant lowering of plasma cholesterol and phospholipids, whereas those high in saturated fatty acids tend to produce the opposite effect. Work currently underway in this laboratory indicated that, at least in the majority of individuals, very reasonable amounts of fat of animal origin may be consumed as long as proper intake of essential fatty acid is assured. The data upon which the above conclusions are based will be presented.

Mr. Taylor will describe some of the purposes and results of the work of the Oregon Wheat Commission.

Hilo Hattie, Hawaii's Ambassadress of Good Will will headline the show being planned for the AACC banquet and dance. Hilo began her career in Hawaii where she joined the Harry Owens group. Since then she has taken leading parts in radio, television, and motion pictures.

Del Courtney, San Francisco's leading radio and television personality, will play for the AACC's banquet show and dance. He has appeared in leading hotels throughout the country as well as the Royal Hawaiian in Honolulu.

The Commission, formed in 1947 and financed by a levy of ½ cent a bushel on all wheat grown in Oregon and sold through commercial channels, is an agency through which the wheat growers of Oregon have made an outstanding effort to deal with their production and marketing problems. Oregon growers also have led the way in organizing growers in other states, and more recently have been active in bringing together representatives of industries in all stages of wheat production and processing to deal with problems of concern to the wheat industry as a whole.

The Preliminary Technical Program, carried in the March issue of *Cereal Science Today*, has a pronounced practical slant. More than 50 papers have been scheduled to date, a goodly number of which should excite the immediate interest of cereal chemists in a variety of industries. Much of the work being reported seems of such practical importance as to entirely justify individual and management approval of the long trek westward for the large population of cereal chemists located in the Eastern half of the country as well as for the Canadian membership.

Seven important papers deal with PRODUCTION AND STORAGE OF CEREALS. L. P. Reitz, of the Field Crops Research Branch, U.S.D.A., Beltsville, Md., discusses "Breeding for Quality"; while A. M. Schlehuber, of Oklahoma A&M College, reports "Progress in Breeding Wheats for Quality in North America."

"Pigments of Wheat Plants as Related to Hessian Fly Resistance and Infestation" is dealt with by Robert M. Grossman and others of Kansas State College. "Insect Infestation of Grain and Cereal Product Contamination" is covered by Kenton L. Harris of the Food and Drug Administration while the University of Minnesota's Moishe Golubchuk relates "The Chitin Content of Wheat as an Index of Mold Contamination."

New data on "Wheat Storage Under Nitrogen" will be given by R. L. Glass, H. V. Hintz, and W. F. Geddes also of the University of Minnesota. D. F. Houston *et al.* have investigated the "Changes in Rough Rice at Different Moisture Contents During Storage at Controlled Temperatures."

Distinguished foreign scientists attending the meeting will present two papers dealing with WHEAT MILLING. Heinz Gehle and Heinz Cleve, Miag Corporation of Braunschweig, Germany, report on "Conditioning of North American Wheat." From Stockport, England, D. G. Elias and R. A. Scott of Henry Simon Ltd., review "Recent Advances in British Milling Technology."

C. R. Harlow of Pillsbury Mills, Inc., Enid, Oklahoma, presents "Recent Developments in Experimental Milling Procedures," while A. A. Ackels of General Mills, Inc., San Francisco, California, should stimulate the membership with "Opportunities Unlimited for the Cereal Chemist and the Operative Miller."

Another seven papers treat FLOUR QUALITY CHARACTERISTICS AND TESTING. From the Osborne Medalist's Grain Research Laboratory in Winnipeg comes a paper co-authored by C. J. Dempster and I. Hlynka reporting the "Effect of Mixing on Physical Properties of Dough."

The subject matter of seventeen papers on BAKING AND BAKERY PRODUCTS, with seventeen more on GENERAL CEREAL SCIENCE AND TECHNOLOGY, promises much in the way of new ideas and useful information for researchers and technicians alike. Space will not allow more than an abbreviated resumé, but the interesting variety of new data can be pictured.

Sure to command close attention will be a report in two parts from the U.S.D.A., Northern Utilitization Research Branch on "Effect of Additives on Crumb Firmness." C. W. Ofelt *et al.* have made a comprehensive study of the action of "Mono and Di-glycerides" and of "Previously Unreported Additives in Relation to Their Chemical Structure."

Also reflecting the advance of cereal science in approaching solution to some of its basic problems are other new reports. Joan Barker and Barbara Kennedy of the University of California are providing "Relationships Between Dough Ingredients, Absorption, and Bread Yield." S. W. Arenson and A. Geisler of Food Development Laboratory in Baltimore report the "Relationship of Glyceride Composition and Processing Methods to Baking Properties of Animal and Vegetable Shortenings in Chemically Leavened and Yeast Fermented Systems." "Functional Factors in Icings for Wrapped, Baked Sweetgoods" are disclosed by Nat H. Nash of American Breddo Corp.; while "White Rings in Frozen Bread" are dealt with by J. W. Pence *et al.* of Western Utilization Research Branch, U.S.D.A.

A study of "Antagonism Between Antioxidants"; "Progress During the Last 12 Months in the Commercial Potential of Ionizing Radiations for the Cereal Industry"; "Effect of Hormones in Feeding of Livestock"; "Function and Valuation of Fats, Oils, and Emulsifiers in Food Products"; "New Developments in Protective Packaging"; "Extraction and Chromatographic Determination of Free Amino Acids in Barley and Malt"; further reflect the practical variety of this fine technical program.

California in May assures the success of a well planned Social Program. Featured will be the President's Reception and a showing of E. F. Seeborg's colored slides of Finland and neighboring countries, Sunday evening. Wednesday evening will bring the Annual Banquet and Dance, while any evening can be enjoyable for all in this exciting city. The Ladies' Program is unusually attractive. They will be feted in "atmosphere, style, and view," while dining in and journeying from one famous spot to another. Cameras are recommended when viewing San Francisco and the Golden Gate from "the Top O' the Mark"; visiting Rod McClellan's 63 "Acres of Orchids"; "the Giant Redwoods"; and while lunching at "Alta Mira at Sausalito"—overlooking San Francisco Bay. San Francisco—Here we come!

RECENT RESEARCH ON OATMEAL[1]

N. L. KENT, Cereals Research Station, St. Albans, Hertfordshire, England

OATMEAL IS THE milled product obtained from groats, the kernel of oat grains; it is used for human consumption mainly in the forms of coarse meal and of flakes, and both products are essentially whole-groat meal.

Requirements of the Raw Material

Oats for milling into oatmeal should give a high yield of sound groats. Important characteristics are kernel content and the condition of the grain, particularly moisture content — which should be low enough for safe storage — and degree of contamination with nonoaten impurities (33). Varieties with white or yellow hull color are preferred to black-hulled varieties; samples with the highest kernel content are preferred both for milling and for feeding to animals. The parts of the oat grain are shown diagrammatically in Fig. 1.

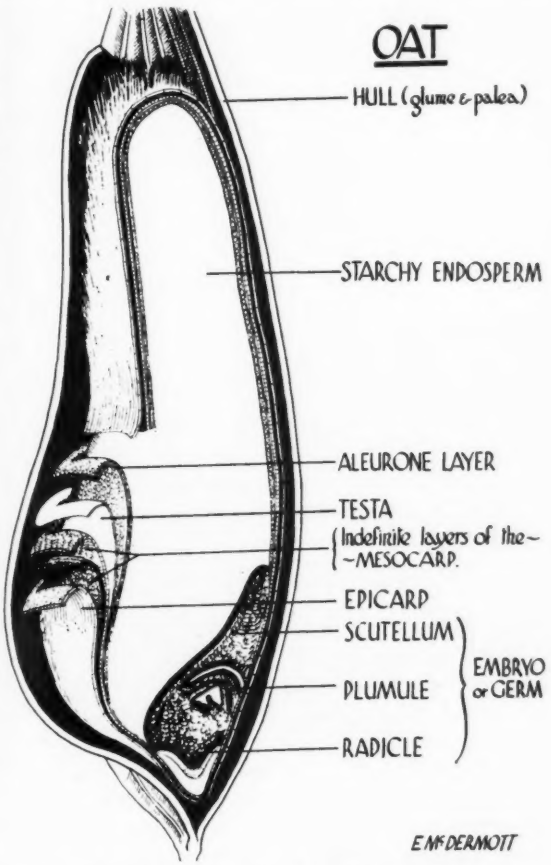


Fig. 1. Diagram of an oat grain in longitudinal section.

Kernel content ranges from 65 to 81% in cleaned British-grown oats, average about 73%, higher kernel content resulting in a correspondingly higher yield of oatmeal. The causes of difference in kernel content between samples are partly varietal and partly environmental in origin (35) (see Fig. 2).

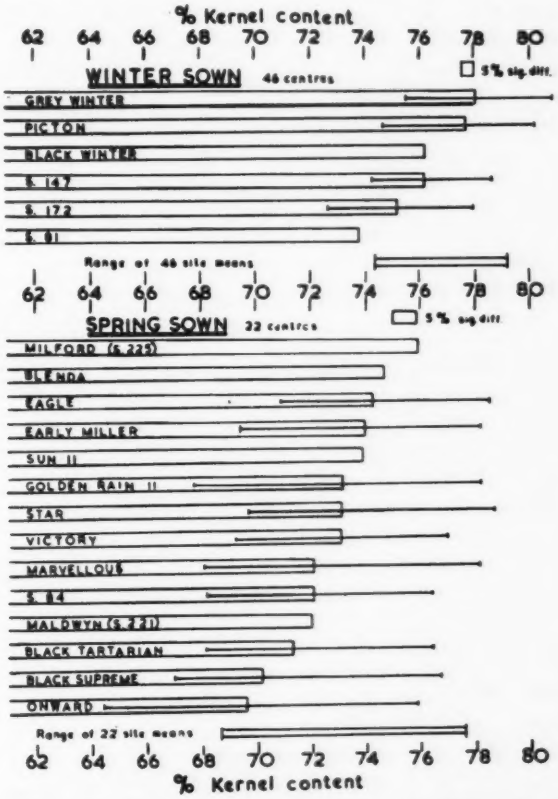


Fig. 2. The mean values for kernel content of six winter-sown and fourteen spring-sown varieties of oats. The range of values encountered when four of the winter varieties were grown together at 46 sites in England and when ten of the spring varieties were grown together at 22 sites is also indicated. (From data given in reference 35).

Kernel content is a characteristic of oats that is taken into consideration by the National Institute of Agricultural Botany when making their recommendations to farmers in Great Britain regarding the merits of new oat varieties under test (65).

Large variations in kernel content exist between grains *within a sample* because individual spikelets in the panicle may contain one, two, or three (infrequently more) grains

[1] Manuscript received September 21, 1956. Presented at the Royal Institute of Chemistry Symposium on "Recent Advances in the Chemistry and Industrial Applications of Cereals" at St. Andrews, Scotland, on June 28, 1956. Contribution from the Research Association of British Flour-Millers, St. Albans, England.

(see Fig. 3). In three-grained spikelets, for example, the first, second, and third grains differ in size and in kernel content: the third grain, although the smallest, has the highest kernel content (34) (see Fig. 3). Nevertheless, the presence of small grains is undesirable because of mechanical difficulties in cleaning and milling (81), samples of uniform grain size being preferred.

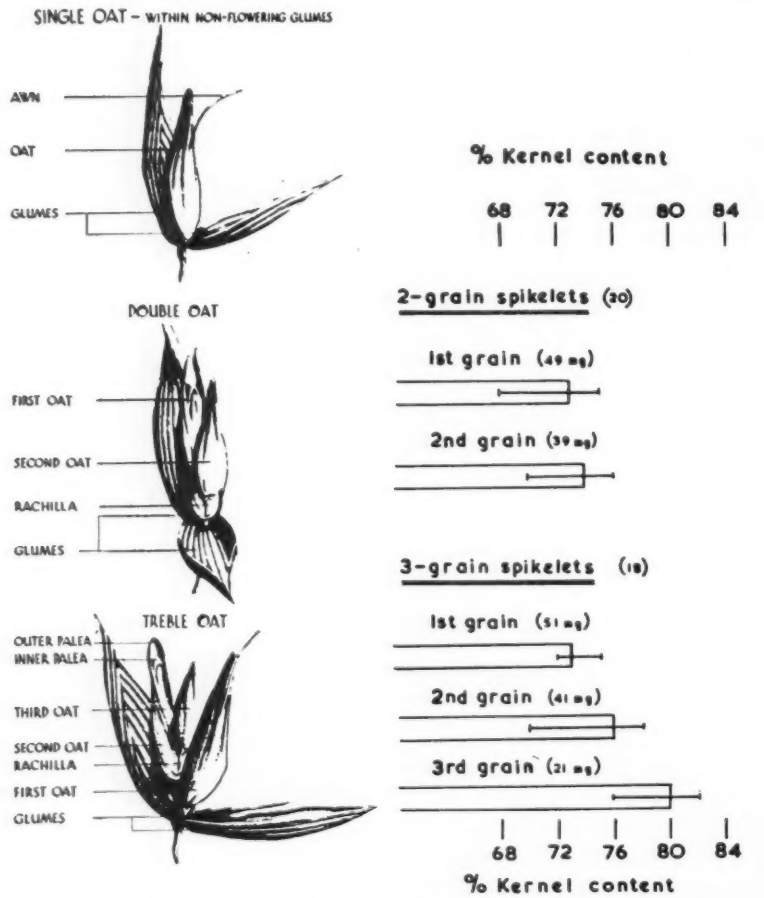


Fig. 3. Oat spikelets containing one, two, or three grains are illustrated on the left; right, the mean value and range of values for kernel content of five of the grain types in the produce of a single panicle of Victory oats; average kernel weights (mg.) in parentheses. (In part from data in reference 34.)

Milling of Oatmeal

The processes involved in the milling of oatmeal differ considerably from those of wheat-flour milling, partly because of differences in form and structure and in chemical composition between oats and wheat, and partly on account of the different purposes for which the products of milling are intended. For example:

a. The oat kernel is enclosed in a fibrous hull, the removal of which is an important stage in the processing.

b. The oil content of the kernel is two to five times as high as that of wheat, and the kernel contains an active lipase enzyme. These facts have an important bearing on the processing of the grain and on the storage life of the product.

c. Oat protein is not in the form of gluten, and oatmeal cannot be used to make an acceptable loaf of bread. The process of milling is adapted to produce oatflakes, a suitable quick-cooking product for porridge-making, and oatmeal for more general purposes, including oatcakes and a slower-cooking porridge.

Clean groats are prepared from oats by the following sequence of processes: cleaning the oats, kiln-drying, grading into sizes, shelling (including dusting and aspirating), separating the groats from unshelled oats, and polishing the groats. In the milling process proper, the groats are cut into small pieces ("pinhead meal"), each kernel yielding four to five pieces of average weight, about 0.6 mg. per particle. From the pinhead meal finer cuts of oatmeal are made by grinding on stones, or oatflakes are made by cooking the meal in a steamer, rolling between heavy rollers, and drying. Oatflakes may also be made from whole groats. There is no attempt at separation of bran from endosperm as in flour milling, and oatmeal is therefore whole-groat meal.

In order to inactivate the enzymes, particularly lipase, the oats are "stabilized" in many mills by steam treatment prior to kiln drying. The steam cooking of the pinhead meal in making flakes is a process essentially similar to stabilization, and in fact generally is adequate to inactivate lipase in oatflakes. However, oatmeal, the finished product, does not pass through the cooker and it is desirable that oats from which *meal* is to be milled should be stabilized by a separate steaming process in advance of kilning.

Lipase and Free Fatty Acids

The enzyme lipase is present and active to a variable extent in all samples of raw oats. In appropriate circumstances lipase tends to split fat, releasing free fatty acids (FFA) and glycerol. All samples of raw undamaged oat kernels as harvested contain 3 – 10% of their fat already in the form of free fatty acids (38). Environmental differences (including post-harvest alteration) account for the major part of this variation, with only minor differences between varieties.

In the normal storage of unmilled raw oats, e.g. at 13% moisture content and 18°C., FFA increase only very slowly, but if oats are crushed, enzyme and substrate are brought together and production of FFA becomes very

noticeable within a few days (41). The rate of reaction is further accelerated by increased moisture content and higher temperature. Lipase activity in oatmeal is responsible for soapy flavors in oatcakes and biscuits, the effect depending on the type of fat used. Its action on oat fat itself gives rise to bitterness (31, 33).

Inactivation of Lipase

Lipase can be inactivated by heat treatment. In earlier days, one function of kiln drying was to reduce lipase activity, although complete inactivation was rarely achieved (33). The necessary temperatures required to inactivate 97–98% of the lipase in oats at various moisture contents by treatment for 1 hour (41) are shown in Fig. 4. During kilning the temperature of the oats often

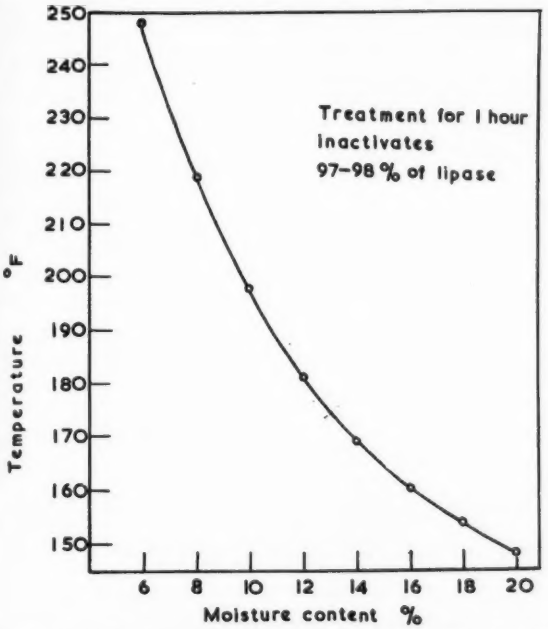


Fig. 4. Grain temperatures that must be maintained for 1 hour in order to inactivate 97–98% of the lipase in oats of various moisture contents. Halving the time of treatment requires an increase of about 4°F. in grain temperature in order to obtain the same degree of inactivation. (From data in reference 41.)

exceeds 90°C. (195°F.), but by the time this temperature has been reached the moisture content has fallen well below 12%, so that the oats when cooled still retain some 20–60% of the original lipase activity (41). It has been claimed (85) that lipase is more completely inactivated in the Swedish wet-hulling process than in the normal kilning process.

All the lipase in the sound ungerminated oat is located in the pericarp of the groat (41). Three methods for inactivating or removing lipase have been devised:

1. Steaming with live steam for 2 minutes at 205–212° F. gives complete inactivation (59). This method is the basis of the commercial stabilization process; it is not ideal, because oxidation of the fat may be encouraged by the heat treatment (41).

2. Soaking the grain in dilute hydrochloric acid for 30 minutes caused 95% inactivation. Neither the germinative ability nor the subsequent development of flavor during kilning was affected (59).

3. Removal of the pericarp by soaking the groats in water and then vigorously scrubbing with a brush (55). About 95% of the pericarp and the lipase contained in it can be removed (the small amount of pericarp in the crease is inaccessible), while the germs remain intact. Removal of the pericarp reduced the fiber content of groats from 1.3 to 0.8%, and improved the Kent-Jones and Martin Color Grade Number of the oatmeal from 17 to 12 (59).

Measurement of Lipase Activity

The hydrolysis of fat by active lipase proceeds very slowly in oatmeal stored at 4% moisture content but is rapid at 40% moisture content, and this fact forms the basis of a rapid test for estimating lipase activity in oatmeal (37). The percentage of fat hydrolyzed is plotted against time (see Fig. 5), and the lipase activity is defined as the rate of hydrolysis at zero time.

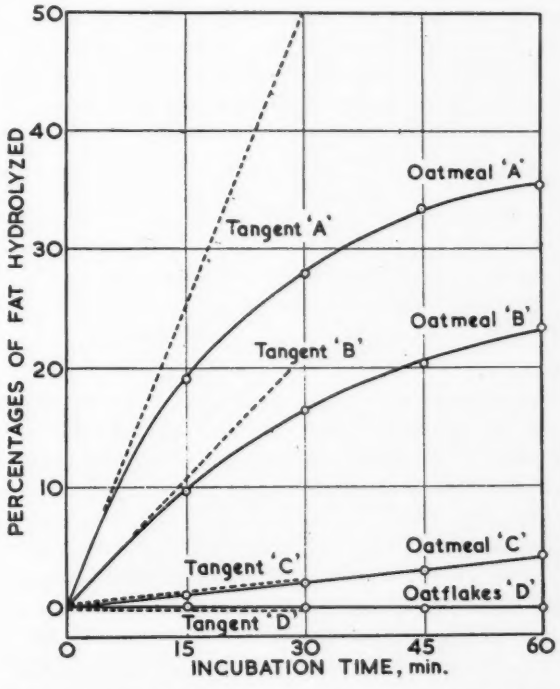


Fig. 5. Progress of hydrolysis in oatmeal doughs at 38% moisture content. (From reference 37.)

Methods involving the incubation of aqueous extracts of the meal with a water-soluble substrate are likely to give unsatisfactory results for lipase activity, probably because of the presence of additional lipase in a less water-soluble form and its incomplete extraction by water (31, 37). Using such methods, anomalous results have been obtained by some workers: Heiss and Purr (26), for example, have reported the development of FFA during the storage of oatmeal described as "lipase-free." Meals

shown by the dough method (37) to be lipase-free have never developed appreciable quantities of FFA on storage for a number of months.

Isolation of Lipase

Oat lipase is not of fungal origin (55). Martin and Peers isolated from groats a fraction representing 0.7% by weight that had a lipase avtivity 2000 times as great as that of the original (55). The enzyme specifically attacked the β-linkage of tributyrin, leaving α, γ-dibutyrin as the product (66). It differed from the lipase isolated from wheat germ and from other sources in not attacking the polyoxyethylene derivative of sorbitan laurate, and in not being activated by compensatory activators required, according to Wilstätter, by pancreatic lipase.

Oat lipase attacks oat oil and olive oil at much the same rate, the activity being optimum at 40% moisture content, and decreasing at both higher and lower moisture contents (40, 55). Activity is practically zero in an aqueous medium (5).

Effect of Steaming on the Milling of Groats

During the second World War the breakdown of groats in the normal flour-milling system was studied (43) and it was found that groats resemble soft English wheat in that fractures tend to occur *across* the endosperm cells, whereas in hard wheat like Manitoba the fractures tend to go *between* the endosperm cells (46). However, if damped groats are gelatinized by steam treatment, the endosperm breaks down into granular particles like a hard wheat, fragmentation then occurring between the cells. Soft English wheat did not undergo any such remarkable change when steamed (32).

Kilning and Flavor

An important characteristic of oatmeal and oatflakes is the traditional aroma and flavor, often described as "nutty." Any flavor in the product is developed during the kilning process in which the oats are dried from an initial moisture content of about 14-20% to a final moisture content of 4–8% (61). The drying is frequently carried out in a Walworth kiln in which the source of heat is a furnace with coke or anthracite as fuel (Fig. 6).

If the grain temperature does not exceed 80°C. (175° F.), no distinctive flavor is obtained; if the temperature is too high the product has an undesirable caramellike or burnt flavor. Under certain conditions of temperature and moisture content, however, a pleasant delicate aroma is developed which is retained for several months in the intact grain (32). Work on development of flavor in oats, carried out at St. Albans by means of model kilns, has shown that:

1. The optimum conditions for flavor development consist in the gentle drying of the grain to about 8% moisture content at a grain temperature not exceeding 80°C. (175°F.), followed by a short toasting for about 20 minutes in a current of air at 150°C. (300°F.) to reduce the moisture content to about 5%. It is essential to use high air temperature at the grain surface of the partly dried oats to get a short severe treatment in the final stage (61).

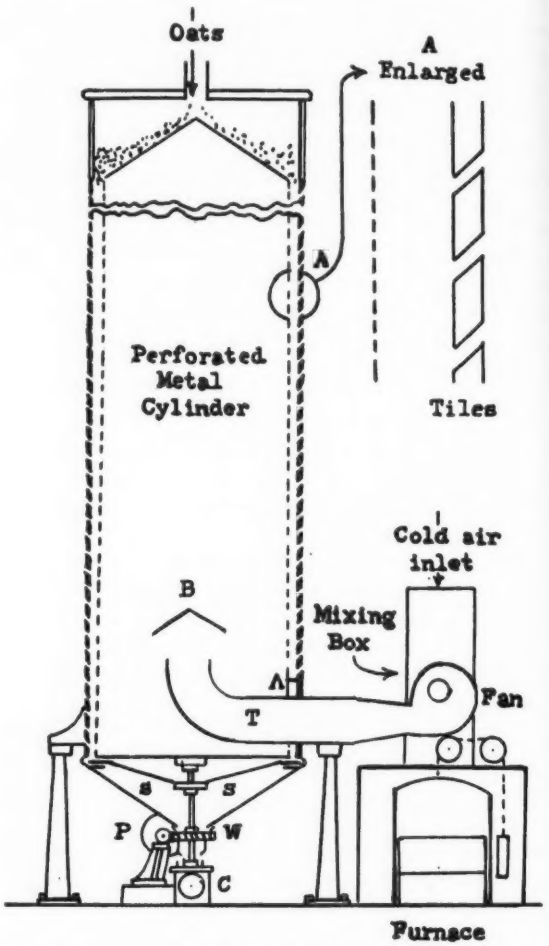


Fig. 6. Diagrammatic vertical section through a Walworth kiln. B, baffle for spreading the hot gases; S, sweeper arms, driven by pulley, P, through worm gear, W, which sweep oats from ledge into worm conveyor, C. T, hot air trunking, covered by penthouse, Λ , where it passes through the kiln walls.

2. Flavor is not affected by wide variations in chemical composition of the oats and can be developed in almost any sound sample (22, 44).

3. Flavor is not due to volatiles derived from the fuel coming into contact with the oats; the same flavor can be obtained when oats are dried by air heated in an electric furnace (61).

4. The hull does not contribute to the flavor; it is possible to develop flavor by kilning *groats* in the laboratory (44).

5. The stabilization treatment does not affect the development of flavor during the subsequent kilning (59).

The ideal sequence of conditions for developing flavor closely resembles that present in the old-fashioned flathead kiln still widely used in Scotland, in which oats are dried in a batch process (44). The need for uniformity

of treatment in kilning is recognized (60), but this is difficult to achieve in practice.

The flavor of bread has been attributed (6) to organic substances produced in the crust at 150°C., ranging from volatile aldehydes to melanoidins, which penetrate into the inner crumb. Similar reactions will occur during the kilning of oats, but other substances must be responsible for the unique flavor of oatmeal, since no such flavor can be developed in wheat subjected to the same heat treatment (61).

The palate is extremely sensitive to the taste of bitterness; furthermore, comparatively small alterations in the chemical structure of a substance may change sweetness to bitterness. Bitter substances are said to fatigue the palate receptors for sweet, sour, and salty tastes (2): hence, the production of comparatively minute amounts of bitterness during kilning will lessen the effect of any good flavor present.

The isolation of a substance responsible for a bitter flavor in oats dried for several hours at >70°C. has been reported (14); it is insoluble in the usual fat solvents but soluble in water.

The quality of oatmeal, e.g., in respect to its suitability for porridge or for oatcake-baking, is surprisingly insensitive both to type of oats used and to large changes in their chemical compostion. However, the replacement of thick-hulled varieties such as Onward, Marvellous, and Yielder by newer varieties of higher kernel content but of similar agricultural merit, e.g., Sun II, Blenda, Milford (S.225), and Picton, is of joint advantage to farmers and millers (33).

Nutritive Value: Oil

The petroleum ether-extractable oil content of the kernel of British-grown oats ranged from 4 to 11% and averaged about 7% (dry-matter basis) in over 1200 samples analyzed at St. Albans. Acid hydrolysis liberates a further 2½% or so of presumably more complex fatty material. The hull has a petroleum ether-extractable oil content of only about 0.2–0.4% (38). Oatmeal has an oil content similar to that of the groats (58).

Oil content is a strongly varietal characteristic; a mean level can be assigned to each variety, about which there is a range of about ±1% among individual samples caused by effects of season or environment, particularly soil (19). If a number of varieties are grown together at different centers the varietal order of merit is fairly well preserved.

Figures obtained (38) for the average oil content of the kernels of 54 varieties of oats are shown in Table I: varietal mean values range from 5.0% (Reliance) to 10.1% (Gordon) on dry-matter basis. Earlier data of Berry (8) gave an almost identical range for 112 varieties: 4.85% (Supreme) to 10.35% (Grey Winter).

The oil content of winter oats tends to be higher than that of spring varieties but it seems unlikely that the difference is related to the seasonal habit of growth.

Variation of oil content within a variety is illustrated by data for 174 samples of Victory groats: Scottish-grown samples averaged 0.3% higher than English-grown samples, a difference that was highly significant (38).

TABLE I

AVERAGE PERCENTAGE OIL CONTENT OF GROATS FROM 54 VARIETIES OF OATS[a]

Variety	Oil Content of Groats[b]	No. of Samples	Variety	Oil Content of Groats[b]	No. of Samples
	Winter oats				
Grey Winter	9.6	46	Unique	8.8	14
S.172	9.2	46	Resistance	7.5	4
Black Winter	9.0	30	S.147	7.4	46
Early Grey Winter	9.0	7	Bountiful	7.4	2
Picton	8.8	46	S.81	7.0	14
	Spring oats				
Gordon	10.1	7	Milford (S.225)	6.5	27
R.30 (Potato)	9.9	3	Primus	6.5	5
Castleton (Potato)	9.4	3	Reagle	6.5	3
Pure Line Potato	9.3	4	Glasnevin Triumph	6.5	2
Sandy	8.9	9	Star	6.4	22
Bell	8.5	4	Victory	6.3	22
Scotch Potato	7.8	5	Abundance	6.3	9
Ayr Line Potato	7.7	7	Orion III	6.2	6
Minor	7.6	10	Albyn Donside	6.2	3
Ayr Bounty	7.5	8	Spitfire	6.0	6
Borris Opus	7.5	2	Glasnevin Ardri	6.0	5
Early Miller	7.4	22	Manna	6.0	2
Eagle	7.3	22	Black Tartarian	5.8	22
Blenda	7.2	23	Yielder	5.8	10
Ayr Ally	7.2	4	M.314	5.8	3
Royal Scot	7.1	3	Bambu	5.8	3
Maldwyn (S.221)	7.1	30	Forward	5.8	13
Sun II	7.0	34	Onward	5.7	22
Craigs Afterlea	6.8	9	Black Supreme	5.4	22
Golden Rain II	6.8	22	Clinton	5.3	5
S.84	6.6	22	Ayr Commando	5.1	14
Marvellous	6.5	22	Reliance	5.0	7

[a] Data from Hutchinson and Martin (ref. 38).
[b] Dry basis.

Many present-day varieties having high oil content also contain a relatively high proportion of kernel and therefore are of greater nutritional value on both scores than varieties such as Onward, characterized by low oil and low kernel content (35, 38).

Figures for the oil content of oat flour of varying extraction rates, milled on conventional wheat roller mills, indicate that there is an oil content gradient in the grain, with a lower value in the interior than in the outer layers (42).

Oat oil consists largely of the gylcerides of unsaturated fatty acids, principally oleic and linoleic (13, 86).

McCance and Glaser (49) found that only about 68% of the oil of oatmeal, determined after acid hydrolysis, was digested by human subjects obtaining 93–100% of their calories from oatmeal. However, the ether-soluble fraction is probably digested to a greater extent.

Nutritive Value: Nitrogen

The average nitrogen content of the kernels of English-grown oats is about 2.4% (39), in comparison with which English wheat has about 1.7% nitrogen content (23). The nitrogen content of oat hulls is about 0.3%.

The range of values for kernel nitrogen content in some thousands of samples (39) was 1.4–3.9% (dry basis), corresponding to a protein range of 8–22% if a factor of

5.7 is employed. The bulk of this variation is due to environmental differences, the kernel nitrogen being closely dependent on the availability of nitrogen in the soil at and around the time of heading (60). Data for nitrogen content of 15 varieties (shown in Table II) reveal only small differences between varietal mean values; however, certain other varieties — e.g., Clinton, Craigs Afterlea, Albyn Donside — invariably have a relatively higher nitrogen content than any of these when grown alongside (39, 84).

TABLE II

NITROGEN CONTENT OF GROATS FROM 15 VARIETIES OF OATS[a]

SPRING-SOWN VARIETIES	RANGE AT 20 CENTERS	MEAN
	%	%
Black Tartarian	2.0–3.8	2.82
S.84	1.8–3.3	2.64
Early Miller	2.0–3.2	2.62
Black Supreme	1.9–3.2	2.53
Golden Rain II	2.0–3.1	2.50
Marvellous	1.8–3.2	2.46
Victory	1.7–3.1	2.45
Onward	1.8–3.1	2.43
Star	1.7–2.9	2.36
Eagle	1.6–3.1	2.34
WINTER-SOWN VARIETIES	**RANGE AT 22 CENTERS**	**MEAN**
	%	%
Black Winter	1.9–3.2	2.58
S.172	2.0–3.2	2.57
S.147	1.9–3.2	2.50
Picton	1.9–3.1	2.39
Grey Winter	1.8–3.1	2.34

[a] Data from Hutchinson and Martin (ref. 39).
[b] Dry basis.

Scottish-grown oats, richer than English samples in oil content, are slightly poorer than English samples in nitrogen content (see Table III), an inverse relationship between oil and nitrogen contents generally existing among samples within a variety (39).

TABLE III

NITROGEN CONTENT OF THE KERNELS OF VICTORY OATS[a]

	SOURCE OF SAMPLES	
	England	Scotland
Number of samples	127	92
Nitrogen content (%)[b]		
Lowest value	1.7	1.7
Highest value	3.4	2.7
Mean value	2.43	2.07
Standard deviation	0.34	0.22

[a] Data from Hutchinson and Martin (ref. 39).
[b] Dry basis.

At certain English centers where the environment is generally warm and dry, the grain ripens before it has finished filling out, so that the kernel, although of high nitrogen content, is lean and small and almost invariably associated with a high proportion of abortive grains — light oats and doubles. The yield of oatmeal obtained is too low for such samples to be acceptable as milling oats (60).

The nitrogen content can be influenced by various agricultural practices: top dressing of spring or winter oats with nitro-chalk increased the protein content of the kernels by up to 2% (18, 22); spray treatment of the oat crop on the farm at an early age with synthetic plant growth regulator herbicides such as MCPA and 2,4-D has been reported (15, 45) to cause an increase in the nitrogen content of the grain in some circumstances.

Nutritive Value: Protein Quality

Heathcote (25) found that amide-nitrogen and the nitrogen in 18 amino acids accounted for over 85% of the total nitrogen in the oat kernel. Nonprotein nitrogen may account for a further 6% of the total nitrogen. Heathcote's figures for samples chosen to cover a wide range of nitrogen content, oil content, etc., are shown in Table IV, with data of McElroy (54) for comparison. The ratio of amino-acid nitrogen to total nitrogen was reasonably independent of the latter, and it was concluded that, in samples with high total nitrogen content, the extra nitrogen due to environmental factors that favor it, e.g., fertilizer treatment, is in the form of useful protein.

TABLE IV

PERCENTAGE OF THE TOTAL NITROGEN OF THE GROAT CONTRIBUTED BY AMMONIA AND AMINO ACIDS

NO. OF SAMPLES	AMMONIA OR AMINO ACID	VALUES FROM HEATHCOTE[a]		VALUES FROM MCELROY *et al.*[b]
		Range[c]	Mean	
4	Ammonia	10.5–12.1	11.2	...
6	Alanine	5.3– 6.3	6.1	...
15	Arginine	12.4–13.2	12.9	12.3
10	Aspartic acid	1.7– 2.8	2.4	...
13	Cystine	1.3– 1.6	1.4	...
10	Glutamic acid	10.7–12.1	11.4	...
10	Glycine	4.6– 4.9	4.7	...
12	Histidine	2.2– 2.8	2.6	2.3
11	Isoleucine	2.2– 4.0	3.3	3.3
11	Leucine	3.5– 4.1	3.8	4.7
10	Lysine	3.4– 4.7	3.8	3.9
13	Methionine	0.8– 0.9	0.8	0.7
15	Phenylalanine	2.4– 2.8	2.6	2.5
13	Proline	3.9– 5.0	4.5	...
6	Serine	3.3– 4.1	3.7	...
11	Threonine	2.4– 2.7	2.5	2.2
12	Tryptophan	1.0– 1.2	1.1	...
15	Tyrosine	1.4– 1.7	1.5	...
10	Valine	4.5– 5.2	5.0	4.2
	Total		85.3	

[a] Reference 25.
[b] Values for Victory oats; data from reference 54.
[c] Total nitrogen content ranged 1.76–3.41%, dry basis.

The usual protein conversion factor for oats, 6.25, was considered by Heathcote to be too high; his results indicated a factor of 5.4 (25).

Nutritive Value: Carbohydrates

The carbohydrates of oatmeal include starch, cellulose, pentosan complexes, gums, and free sugars. They are responsible in part for the sweet flavor of porridge and its thickening during cooking.

Starch, the major component, is present to the extent of about 50% in Scottish oats (12), equivalent to about 65% in oatmeal.

Anderson and Greenwood (3) used a graded extraction procedure with cold and hot water and 5% alkali for investigating the polysaccharides of oats. Their best starch fraction (nitrogen: 0.03%) contained 26% of amylose. The ratio of nonterminal to terminal glucose units was

27.4, the average chain length of the amylopectin component 20 glucose units. They found water-soluble pentosans and glucosans other than starch, but could detect no sharp differentiation between the water-soluble and the hemicellulosic materials present.

The rate of breakdown of oat starch by human fasting duodenal juice was equal to that of barley, rye, and maize starches; potato starch was broken down faster, wheat starch more slowly (79).

Macleod and Preece (53) report the presence of about 1% of water-soluble free sugars, consisting of sucrose (58%), raffinose (17%), glucodifructose, fructosans, and small amounts of fructose and glucose. Anderson and Greenwood give similar figures (3). Schlubach and Müller (78) claim to have extracted from oats a polyfructosan ("avenarin") based on seven fructofuranose units.

Preece and coworkers (53, 68–71) investigated the water-soluble gums, present in oats to the extent of about 2%. Of these, 87% was laevorotatory β-glucosan, the remainder pentosan and dextrin (71). The gum from oats had a low viscosity. Using ammonium sulfate fractionation they obtained a high-molecular water-soluble β-glucosan free from pentosans (69), while fractions containing arabinose and galactose free from glucose and xylose residues were obtained by paper electrophoresis (70). These workers have made comparisons between rye, barley, wheat, oats, and maize, and suggest that oats, in its soluble carbohydrates, shows a pattern intermediate between those of maize, on one hand, and rye, barley, and wheat, on the other. They suggest these differences may be related to the degree of development reached when the crop is adjudged ripe (53, 69). Similarly, the carbohydrate-splitting enzymes show interesting differences among the cereals (68).

The same workers (68) suggest that the poly-β-glucosan component of oat gum has affinities with lichenin from Iceland moss, a glucosan with 1:3- and 1:4-β-linkages. Other workers (1, 47, 62) claim the isolation of lichenin from oats, said to differ from moss lichenin in some respects (1). Letzig (47) claims a valuable dietary action for porridge in digestive troubles, and ascribes it to a protective mucilage formed when lichenin is decomposed by lichenase. According to Müller (63) the β-glucosidic linkage in lichenin is unattacked by human enzymes.

As yet, the less soluble carbohydrates in oats, other than starch, appear to have received but little attention, although Anderson and Greenwood have drawn attention to the presence of hemicelluloses in these ill-defined materials (3).

Nutritive Value: Vitamin B_1

Oatmeal is a good source of vitamin B_1, 2 ozs. of meal supplying one-fourth to one-third of the daily requirements (44).

Hinton (28) showed by his dissection technique that the scutellum accounted for 28% of the total B_1 in a normal sample of groats, a smaller proportion than in wheat.

Holman and Godden (29) reported data from which the average B_1 content of the kernels of Scottish oats may be calculated as 5.4 γ/g (dry basis). There was a significant positive correlation ($r = +0.42$) between thiamine and protein contents. The hull of the mature oat grain contains no thiamine.

Figures recently obtained by Ridyard, using a modification of the thiochrome method involving the removal of interfering substances, indicate that the B_1 content of native oats is some 20% higher than earlier values have suggested (73). A loss of about 18% of the thiamine due to kiln drying has been reported (29); the oatmeal and the kernels of the oats from which it was milled had practically identical B_1 values.

Nutritive Value: Niacin and Riboflavin

Oats are recognized as being deficient in niacin, values of 5–7 γ/g being reported for home-grown oats (7), 4–12 γ/g for American oats (17), in comparison with about 48 γ/g for English wheat (52). The riboflavin content of oats, about 1.2–1.3 γ/g (16, 30, 74) is similar to that of wheat.

A highly significant correlation ($r = +0.7$) was found between niacin and protein contents (17), and between niacin and riboflavin contents ($r = +0.72$); it was concluded that oat varieties can be bred with much higher riboflavin and niacin contents than those now being grown (16).

It has been reported (30, 80) that the niacin content of oat hulls is as great as or greater than that of the groats.

Nutritive Value: Phosphorus

The total phosphorus content of whole groats is about 4 mg/g (4, 42). Of this about 65% is in the form of phytate phosphorus. The content of phytic acid increases from the center of the groat to the cortical layers (67). McCance and Widdowson (50) reported that phytic acid phosphorus constituted 42% of the total phosphorus in oatmeal.

The rachitogenic effect of the phytin in oatmeal is well known (56), and the absence of active phytase in ripe oats (27) causes this effect to be greater in oatmeal than in whole wheat (51).

Bronner *et al.* (9) studied the effect of food phytates on the uptake of calcium, using the radioactive isotope Ca^{45}, in children on low-calcium breakfasts. The uptake from a farina breakfast was 76%, from oatmeal 55%; but from farina with added sodium phytate equivalent in quantity to the phytic phosphorus supplied by the oats, only 34%. They concluded that phytate is not of great significance in American diets.

Gorter (20), in a recent review, concluded that there is no evidence that in a normal diet phytic acid in porridge leads to a permanent disturbance of calcium retention.

Purity of Products

Impurities that may occasionally be present in oatmeal and oatflakes include fragments of husk, discolored particles of groat, rodent hairs, and insect fragments.

Discolored particles are considered, in some cases, to be due to weathered oats, and in others, to be derived from decayed grains which result from an infestation of the farm crop by frit fly, *Oscinella frit* LINN, a pest that is particularly troublesome in central and southeastern England (36, 83).

Rodent and insect contamination of oat products can be detected by the modified filth test published by Hart and Heighton (24).

Cooking of Porridge

Lincoln, Hove, and Harrell (48) have reported on the extent of destruction of vitamin B_1 that occurs during the cooking of oatmeal. Excessive cooking, as may happen in institutions where porridge is cooked in large batches, could lead to a small loss of B_1 (e.g., 10% loss after 1 hour's cooking), but cooking for 5 minutes, which is sufficient for oatmeal in a small pan, entailed no loss of B_1.

Recent work by Bryan (11) showed that the pitting which occurred in an aluminum saucepan used exclusively for the cooking of porridge was due not to the oatmeal, but to traces of copper in the domestic water supply. The starch and other colloids in oatmeal had a restraining action on the corrosive agents.

Keeping Quality of Oatmeal: Antioxidants

The bitter and rancid flavors that sometimes develop in stored oat products have been investigated in relation to enzymic breakdown and oxidation of oat fat (14, 77). Bitter substances extracted from oatmeal have been identified as a saponin (57), or as a glycoside linked to a saponin (76).

The fat of milled oat products, particularly the less stable, unsaturated portion of the fat, absorbs oxygen from the air and acquires an odor of rancidity. However, oats also contain antioxidants which protect the fat during an induction period.

Hutchinson recovered from oatmeal a fraction with antioxidant activity which was soluble in petroleum ether but insoluble in acetone; it comprised 4–12% of the total petroleum-ether extract. Other antioxidant material of a different chemical nature remained in the defatted residue (32).

Prolonged kilning, particularly at high temperatures, and prolonged steaming appreciably reduce the induction period, although short sharp periods of heating may be of advantage in producing new antioxidant material (32). Oxidative rancidity is of particular importance in the production of ready-to-eat oat products by processes involving the high temperatures necessary to cause dextrinization or caramelization (31).

Tocopherol, a substance of known antioxidant activity, has been estimated chromatographically in oats: concentrations of 0.6 mg. of tocopherol per g. of oat oil (21), and 1.7–3.2 mg. per 100 g. of oats (dry basis) (10) have been reported.

Oat flour itself has been used as an antioxidant material, e.g. by Musher in the United States, under the names Aveen, Avenex, etc. Musher (64) claimed that paper treated with Avenex prevented oxidation and rancidification of fats wrapped in it. These products have a high protein content (20 to 30%), and it has been claimed (82) that the stabilizing action of oat flour is dependent on the presence of native protein. Purr (72) found that increase in antioxidant activity brought about by pretreatment of the oat occurred in conjunction with structural changes in the protein. Oat flour, used as an antioxidant, extended the induction period of butter containing 10 p.p.m. of copper from 3 weeks to 22 weeks; nordihydroguaiaretic acid (NDHG) extended it to 28 weeks (75).

Literature Cited

1. ACKER, L., DIEMAIR, W., and SAMHAMMER, E. *Z. Lebensm. Untersuch. u. Forsch. 100:* 180–188; *102:* 225–231 (1955).
2. ALLEN, F., and WEINBERG, M. *Quart. J. Exp. Physiol. 15:* 385–420 (1925).
3. ANDERSON, D. M. W., and GREENWOOD, C. T. *J. Sci. Food Agr. 6:* 587–592 (1955).
4. BAILEY, L. H., CAPEN, R. G., and LE CLERC, J. A. *Cereal Chem. 12:* 441–472 (1935).
5. BAINS, G. S., and BHATIA, D. S. *Science and Culture* (India) *18:* 387–388 (1953).
6. BAKER, J. C., PARKER, H. K., and FORTMANN, K. L. *Cereal Chem. 30:* 22–30 (1953).
7. BARTON-WRIGHT, E. C. *Biochem. J.* (London) *38:* 314–319 (1944).
8. BERRY, R. A. *J. Agr. Sci. 10:* 360–414 (1920).
9. BRONNER, F., HARRIS, R. S., MALETSKOS, C. J., and BENDA, C. E. *J. Nutrition 54:* 523–542 (1954).
10. BROWN, F. *J. Sci. Food Agr. 4:* 161–165 (1953).
11. BRYAN, J. M. *J. Sci. Food Agr. 6:* 305–311 (1955).
12. CLEGG, K. M. *J. Sci. Food Agr. 7:* 40–44 (1956).
13. CRUICKSHANK, E. M. *J. Agr. Sci. 27:* 309–315 (1937).
14. DIEMAIR, W., and JANECKE, H. *Anales bromatol. 2:* 341–347 (1950).
15. ELLIOTT, J. G. *Agriculture* (Engl.) *62:* 574–577 (1956).
16. FREY, K. J., HALL, H. H., and SHEKLETON, M. C. *J. Agr. Food Chem. 3:* 946–948 (1955).
17. FREY, K. J., and WATSON, G. I. *Agron. J. 42:* 434–436 (1950).
18. GARDNER, H. W. *Agriculture* (Engl.) *60:* 328–334 (1953).
19. GARDNER, H. W., and HUTCHINSON, J. B. *Agriculture* (Engl.) *58:* 208–216 (1951).
20. GORTER, A. *Voeding 15:* 145–158 (1954).
21. GREEN, J., MARCINKIEWICZ, S., and WATT, P. R. *J. Sci. Food Agr. 6:* 274–282 (1955).
22. GREER, E. N. *In* Food Science. A symposium on Quality and Preservation of Food. Ed. BATE-SMITH, E. C., and MORRIS, T. N. pp. 88–100. Cambridge University Press (1952).
23. GREER, E. N., RIDYARD, H. N., and KENT, N. L. *J. Sci. Food Agr. 3:* 12–15 (1952).
24. HART, H. V., and HEIGHTON, A. M. *Analyst 78:* 439–440 (1953).
25. HEATHCOTE, J. G., *Brit. J. Nutrition 4:* 145–154 (1950).
26. HEISS, R., and PURR, A. *Deut. Lebensm. Rundschau 50:* 186–192; 225–229 (1954).
27. HILL, R., and TYLER, C. *J. Agr. Sci. 44:* 306–310 (1954).
28. HINTON, J. J. C. *Biochem. J.* (London) *38:* 214–217 (1944).
29. HOLMAN, W. I. M., and GODDEN, W. *J. Agr. Sci. 37:* 51–57 (1947).
30. HUNT, C. H., RODRIGUEZ, L. D., and BETHKE, R. M. *Cereal Chem. 27:* 79–96 (1950).
31. HUTCHINSON, J. B. *Milling* (Liverpool) *112:* 528–533 (1949).
32. HUTCHINSON, J. B. *Milling* (Liverpool) *116:* 692–693 (1951).
33. HUTCHINSON, J. B. *Chemistry & Industry:* 578–581 (1953).
34. HUTCHINSON, J. B., KENT, N. L., and MARTIN, H. F. *J. Natl. Inst. Agr. Bot.* (England) *6:* 149–160 (1952).
35. HUTCHINSON, J. B., KENT, N. L., and MARTIN, H. F. *J. Natl. Inst. Agr. Bot.* (England) *6:* 443–453 (1953).
36. HUTCHINSON, J. B., KENT, N. L., and MARTIN, H. F. *J. Natl. Inst. Agr. Bot.* (England) *7:* 24–32 (1954).

37. HUTCHINSON, J. B., and MARTIN, H. F. *J. Sci. Food Agr. 3:* 312–315 (1952).
38. HUTCHINSON, J. B., and MARTIN, H. F. *J. Agr. Sci. 45:* 411–418 (1955).
39. HUTCHINSON, J. B., and MARTIN, H. F. *J. Agr. Sci. 45:* 419–427 (1955).
40. HUTCHINSON, J. B., and MARTIN, H. F. Unpublished data.
41. HUTCHINSON, J. B., MARTIN, H. F., and MORAN, T. *Nature 167:* 758 (1951).
42. JONES, C. R., and HUTCHINSON, J. B. *Cereal Chem. 22:* 538–546 (1945).
43. JONES, C. R., SIMPSON, A. G., and KENT, N. L. *Milling* (Liverpool) *100:* 230–233; 242–244; 261–263 (1943).
44. KENT, N. L. *Milling* (Liverpool) *124:* 632–636 (1955).
45. KENT, N. L., and HUTCHINSON, J. B. *Ann. Appl. Biol.* (in press).
46. KENT, N. L., and JONES, C. R. *Cereal Chem. 29:* 383–398 (1952).
47. LETZIG, E. *Z. Lebensm. Untersuch. u. Forsch. 92:* 170–178 (1951).
48. LINCOLN, H., HOVE, E. L., and HARREL, C. G. *Cereal Chem. 21:* 274–279 (1944).
49. MCCANCE, R. A., and GLASER, E. M. *Brit. J. Nutrition 2:* 221–228 (1948).
50. MCCANCE, R. A., and WIDDOWSON, E. M. *Med. Research Council* (Brit.) *Spec. Rep. Ser.* No. *235* (1940).
51. MCCANCE, R. A., and WIDDOWSON, E. M. *Brit. J. Nutrition 2:* 401–403 (1948).
52. MCCANCE, R. A., WIDDOWSON, E. M., MORAN, T., PRINGLE, W. J. S., and MACRAE, T. F. *Biochem. J.* (London) *39:* 212–222 (1945).
53. MACLEOD, A. M., and PREECE, I. A. *J. Inst. Brew. 60:* 46–55 (1954).
54. MCELROY, L. W., CLANDININ, D. R., LOBAY, W., and PETHYBRIDGE, S. I. *J. Nutrition 37:* 329–336 (1949).
55. MARTIN, H. F., and PEERS, F. G. *Biochem. J.* (London) *55:* 523–529 (1953).
56. MELLANBY, E. *Med. Research Council* (Brit.) *Spec. Rep. Ser.* No. *93* (1925).
57. MOHR, W. *Deut. Lebensm. Rundschau 49:* 127–131 (1953).
58. MOIR, H. C. *Chemistry & Industry 61:* 17–21 (1942).
59. MORAN, T. *Milling* (Liverpool) 116: 532 (1951); *Food Manuf. 27:* 73–74 (1952).
60. MORAN, T. *Milling* (Liverpool) *122:* 596–598 (1954).
61. MORAN, T., HUTCHINSON, J. B., and THOMLINSON, J. *Nature 174:* 458 (1954).
62. MORRIS, D. L. *J. Biol. Chem. 142:* 881–891 (1942).
63. MÜLLER, E. *Z. Kinderheilk. 71:* 120–135 (1952).
64. MUSHER, S. *Paper Trade J. 110:* 117–120 (1940).
65. NATIONAL INSTITUTE OF AGRICULTURAL BOTANY. Farmers' Leaflets Nos. *9* and *13. Natl. Inst. Agr. Bot.* (England) (1956).
66. PEERS, F. G. *Nature 171:* 981 (1953).
67. PEREIRA, A., and DE OLIVEIRA, J. N. *Anales bromatol. 5:* 171–176; 185–187 (1953).
68. PREECE, I. A., AITKEN, R. A., and DICK, J. A. *J. Inst. Brew. 60:* 497–507 (1954).
69. PREECE, I. A., and HOBKIRK, R. *J. Inst. Brew. 59:* 385–392 (1953).
70. PREECE, I. A., and HOBKIRK, R. *Chemistry & Industry:* 257–258 (1955).
71. PREECE, I. A., and MACKENZIE, K. G. *J. Inst. Brew. 58:* 457–464 (1952).
72. PURR, A. *Deut. Lebensm. Rundschau 49:* 186–190; 205–213 (1953).
73. RIDYARD, H. N. Unpublished data.
74. ROBINSON, A. D., TOBIAS, C. H., and MILES, BARBARA J. *Can. J. Research 28F:* 341–350 (1950).
75. ROBINSON, HELEN M. *Food Technol. 5:* 20–24 (1951).
76. ROHRLICH, M., and TRAIN, G. *Getreide, Mehl u. Brot 3:* 61–64 (1953); *Z. Lebensm. Untersuch. u. Forsch. 99:* 346–351 (1954).
77. ROTHE, M. *Fette u. Seifen 55:* 877–880 (1953); *56:* 667–670 (1954).
78. SCHLUBACH, H. H., and MÜLLER, H. *Ann. 572:* 106–114 (1951).
79. SEIGE, K. *Deut. Z. Verdauungs- u. Stoffwechselkrankh. 14:* 180–187; 224–233 (1954).
80. SHAW, B. Unpublished data.
81. SWORD, J. *Scot. Agr. 28:* 137–148 (1948–9); *28:* 214–218 (1949).
82. TÄUFEL, K., and ROTHE, H. *Fette u. Seifen 51:* 100–102 (1944).
83. THOMAS, J. D. *Plant Pathology 3:* 55–58 (1954).
84. WATERSON, H. A., and KENT, N. L. *J. Natl. Inst. Agr. Bot.* (England) *7:* 536–550 (1956).
85. WIDHE, T., and ONSELIUS, T. *Cereal Chem. 26:* 393–398 (1949).
86. WILLARD, CONSTANCE, ENGLERT, R. D., and RICHARDS, L. M. *J. Am. Oil Chemists' Soc. 31:* 135 (1954).

ERRATUM

Cereal Science Today, Vol. 2, No. 3, March 1957, pages 62 and 63.

The editors regret that the following corrections are necessary in the above article:

On page 62, second column, delete last line beginning, "the applications . . ."

On page 63, first column, delete first four lines beginning, "ly recording . . ."

On page 63, second column, the last paragraph should read as follows:

> In concluding this very brief survey, the author would like to quote from a review by O'Connor (35) discussing the applications of infrared spectrophotometry and describing a machine for sorting infrared spectra recorded on punched cards. He says, "This technique is no longer a wild proposal. The analytical laboratory of tomorrow, consisting of merely one or more streamlined automatically recording infrared spectrophotometers, a sorter, and files of punched cards, will differ greatly in appearance from the typical wet-method analytical laboratory of today."

• • • People

W. Hugh Adcock, branch sales manager of Corn Products Refining Co.'s Atlanta office, took part in the "Atlanta Boosters" radio program on February 24, which saluted Corn Products for its outstanding achievements.

Thomas G. Alleman joins analytical staff of research and development department of Procter & Gamble.

William E. Anderson named managing editor (formerly associate editor) of **Chemical Engineering Progress,** publication of American Institute of Chemical Engineers.

Warren Averill named associate professor of food technology at University of Massachusetts.

Charles W. Bayley, Jr., and **Austin I. Weber,** research and development chemists, join staff of coatings and adhesives department of Borden's chemical division. **Philip E. Coyle, Jr.,** new technical sales representative.

Edward F. Bouchard named assistant director of technical service department, Chas. Pfizer & Co.; succeeded by Arthur F. Leyden as manager of pharmaceutical section.

B. H. Ershoff, from University of Southern California, named head of newly established western branch of Food Research Laboratories, Inc., Los Angeles.

James W. Evans, director of research for American Maize-Products Co., Hammond, Indiana, was selected to participate in the 31st session (Feb. 20 to May 17) of Harvard University's Advanced Management Program, an intensive course of study for experienced business executives. Dr. Evans joined American Maize in 1950 after working for Union Starch and Refining Co., Granite City, Ill., and later General Mills research department, Minneapolis. His special interests include starches, dextrins, syrups, and sugars, and the development of packaged soups, mixes, and puddings.

Leo ("Lee") Freud, 53, New York City technical sales and services representative of Fries & Fries, Inc., died suddenly on February 11 at his home in Beech Hurst, New York. An associate of Fries & Fries for more than 30 years, Mr. Freud was widely recognized for his specialized knowledge of food and beverage flavorings.

Richard E. Hein, former associate professor of chemistry at Kansas State College, joins Mellon Institute as administrative fellow on Food Varieties Fellowship sponsored by Heinz Co.

David B. Hester joins progress department staff of Procter & Gamble in research and development.

William A. Mitchell, president of Central Trust Co., elected to board of directors of National Starch Products.

John R. Murray, vp of Quaker Oats Co., Chicago, received an award from the Illinois Foundation of the Future Farmers of America in recognition of the contribution made by Mr. Murray's Creek Bend Farms, St. Charles, Ill., to the work of the Foundation and in helping youth to become rural leaders.

Roy C. Newton, vp Swift & Co., will receive the 1957 Gold Medal of the American Institute of Chemists in recognition of his leadership in food technology and service to the profession. At Swift, Newton has been vp since 1941 and has helped build a research staff that has contributed hundreds of improved forms of food and food products. He joined the company as research chemist in 1924.

Russell A. Rasmussen joins Peter Hand Foundation, a division of Peter Hand Brewery Co., Chicago.

Herbert J. Schoepe joins S. B. Penick Co.

Thomas H. Vaughn named executive vp in charge of corporate development of Pabst Brewing Co.

William J. Ward named leader of special projects section of General Mills research lab., chemical engineering department.

• • • Products

A piece of apparatus designed to help with problems of cost for labor and production is the Operations Recorder, model MD-Jr. It consists of a drum which rotates at speeds from 4 minutes to 24 hours per turn (as ordered) and records graphically when a machine or device is operating or when an operator is producing. It "shows who . . . when . . . for how long." No ink is used. A stylus rests against the chart paper with its adherent layer of white opaque wax crystals; the pressure of the stylus exposes the strongly contrasting color of the reverse side of the paper and produces a slightly spiral tracing on the chart. With the 24-hour rotation model, any given instant of successive days is instantly comparable since they line up vertically. A clear transparent cover prevents tampering, keeps out dust, and permits the worker to see his production record as it is being made. Gorrell and Gorrell, Haworth, N. J., are the distributors. They will send a sample of the chart paper with tracings.

• • •

A 20-page catalog is available from Arthur S. LaPine & Co., Chicago, listing with full-page descriptions their crystal lattice models, organic molecular models, new Beckman Pocket pH Meters, new model Thelco ovens, analytical and dispensing balances, a variety of stirrers, laboratory carts, and many other items in a review of the year's best sellers. Ask for "Lanco Apparatus Review No. 7" and address the company at 6001 South Knox Ave., Chicago 29.

• • •

Rapistan gravity and power belt conveyors used in various industrial operations are shown in a new 4-page folder issued by the Rapids-Standard Co., Inc., Grand Rapids, Mich. The folder describes the use of basic "packaged" conveyor units, portable lines, and controlled flow systems, with photographs of conveyors being used in receiving, work in process, warehousing, ship-

ping, packaging, order selection, and other areas. Nationwide representatives of the firm are listed. For Form IND-1 address the company at 342 Rapistan Bldg., Grand Rapids 2.

• • •

American Brands, Inc., is a new corporation formed to market "exciting new products in the food field" from its headquarters at 550 Fifth Avenue, New York City. At the National Food Brokers Convention in Chicago on February 18 its first product to be introduced nationally was shown, an instant liquid pure tea concentrate, under the brand name "2 Sec'n Tea."

• • • Patter

Latest releases indicate that members of the American Society of Brewing Chemists can look forward to a stimulating and enjoyable meeting at Hotel Barbizon Plaza in New York City, May 4 to 9. Committee meetings and technical sessions will be tucked under the belt and then will come the "froth" – the "Maltster's Function," buffet lunch including the ladies, curbside discussions for informal exchange of ideas, president's reception, plant visitations, United Nations tours and a U.N. film, "Assignment Children" with Danny Kaye, New York Coliseum Exhibition, boat rides around Manhattan, and other attractions. The program as announced appears to be most interesting. More information can be had from Malvin J. Mayer, 230 Washington Street, Mount Vernon, New York.

• • •

The Second National Wheat Research Conference will be held October 1-2 at the agricultural research laboratory of the U. S. Department of Agriculture, Peoria, Ill., under Millers' National Federation auspices. The program will be considerably broader than the first conference last June. It is expected that progress reports will be available by October on several important pieces of wheat research, some of them new and some continuations of earlier studies. Work is under way in Peoria and in the western laboratory at Albany, Calif., and other projects are being done under contract at state experiment stations and universities. The program will be issued a month or so in advance of the October conference.

• • •

Aimed at correction of the technical manpower shortage, a technical Personnel Recruiting Exposition will be held in Chicago at the Sherman Hotel, June 8 to 12, in conjunction with the National Technical Career Conference. Exhibitors from leading research and manufacturing organizations will offer information about the job and the company behind it on a scale that makes this an excellent opportunity for holders of science and engineering degrees to choose a professional career, making maximum use of their abilities. A series of panel discussions will be led by nationally known figures. There is no registration charge, but registrations must be made in advance. For forms write the director, Marcus W. Hinson, % Technical Career Conference, 19 South LaSalle St., Chicago 3, Ill.

• • •

The American Dry Milk Institute, Inc., announces its 32nd annual meeting, April 16-17 at the Edgewater Beach Hotel, Chicago, with a program stressing quality processing, markets, and sales. There will be both a technical dinner (an informative forum of technical men) and a dinner "for home economists on member staffs, or in teaching or business." Entertainment includes a dinner-dance in the Polynesian Village. Director is B. W. Fairbanks, 221 North LaSalle St., Chicago 1.

• • •

Corn Products Refining Company was saluted on a half-hour radio program broadcast from Atlanta, Georgia, on February 24. The program outlined the uses of many of the hundreds of products made from corn, and traced the company's development in manufacturing its many well-known consumer products and more than 450 industrial products for over 60 basic industries. Among the latter are the various starches used in textile making and paper manufacture; corn syrups and dextrose used in the canning industry and the baking trade; and a number of products used by foundries in making castings – all industries highly active in the South. The program demonstrated how one or more of the company's materials goes into the making of many articles in general and household use, such as furniture, wearing apparel, and soaps and cleansers.

The company's president, William T. Brady, spoke from New York and returned the compliment with his enthusiasm for the future of the South, mentioning the new vitality which he finds so evident in that area, nowhere more apparent than in Atlanta.

• • •

Procter & Gamble Company has been cited as the best-managed company in the U. S., according to a special Management Audit just published by the American Institute of Management, nonprofit research foundation devoted to the study and evaluation of business managements. Some of the individual points of excellence in the rating are: Leadership in social changes among employees for three generations – disability benefits and stock ownership, profit - sharing, guaranteed employment plan; its top position in research; its continuous improvement of manufactured products which has constantly lowered costs; a young, unified, and dynamic executive team; and no blind spots in management efforts.

• • •

Discussions of milling economics will be featured at the 55th annual convention of Millers' National Federation, to be held at the Drake Hotel, Chicago, on May 15, 16, and 17. Two half-day sessions are being reserved for subjects related directly to the milling business, one of these a closed meeting strictly for millers.

Opening speaker at the first general session, Thursday afternoon, will be Frederick J. Stare, head of the Harvard School of Public Health. He will speak on the fats issue in relation to heart trouble and what this may mean to the cereal industries. Dr. Stare has long been friendly to wheat products, and has worldwide standing as an authority in nutrition.

• • •

The Food and Drug Administration proposes to reduce the minimum daily requirement for riboflavin from 2 mg. daily to 1 mg. The original finding, made in 1941, was based upon rather limited evidence, and nutrition scientists are now agreed that it is higher than necessary. Heretofore no m.d.r. has been established for niacin, but Food and Drug now proposes to set this at 10 mg. Should these proposals be made effective, the package label on enriched flour may state that 8 oz. of enriched flour supplies, among other things, 60% of m.d.r. of riboflavin (instead of the present 30%) and 80% of m.d.r. of niacin.

BOOK reviews

Advances in Enzymology, Vol. 17, ed. by F. F. Nord. Interscience Publishers Inc., New York, 1956. Reviewed by S. KIRKWOOD, University of Minnesota.

This is the most recent volume in this well-known series. The titles and authors of the articles give the best brief summary of the book.

I. R. A. Alberty, Enzyme kinetics.
II. Britton Chance and G. R. Williams, The respiratory chain and oxidative phosphorylation.
III. Ines Mandl and Carl Neuberg, Solubilization, migration, and utilization of insoluble matter in nature.
IV. Bernard Axelrod, Enzymatic phosphate transfer.
V. Jeffrey Edelman, The formation of oligosaccharides by enzymic transglycosylation.
VI. H. R. Mahler, Nature and function of metalloflavoproteins.
VII. E. C. De Renzo, Chemistry and biochemistry of xanthine oxidase.
VIII. W. W. Waino and S. J. Cooperstein, Some controversial aspects of the mammalian cytochromes.
IX. A. Gib DeBusk, Metabolic aspects of chemical genetics.
X. R. Jeener, Ribonucleic acids and virus multiplication.

Chapter I is an excellent source of material and information for the enzymologist whose primary interest is not in kinetics. A full discussion of the application of steady-state kinetics to the various factors which affect the velocity of enzyme-catalyzed reactions is given. The author does not waste space on derivations, but gives references which permit the reader to follow the derivation if he is so inclined. In all cases the possibilities of the kinetic approach are clearly outlined. The chapter closes with a discussion of the status of the kinetics of six well-studied enzyme-catalyzed reactions.

Chapter II consists partially of a valuable review of the work done in Dr. Chance's laboratory on the subject of oxidative phosphorylation, including studies on the over-all process as it occurs in the mitochondrion, in the intact cell, and in solid tissue. The chapter is marked by several frank statements of opinion on controversial subjects which are, in the reviewer's opinion, very worthwhile. Nothing is accomplished by ignoring differences of opinion.

Chapter III is a provocative discussion of a subject which has, as yet, not received the attention that its importance merits.

Chapter IV is a discussion of the most recent work in a very important field. It includes a short discussion of nomenclature which points out the difficulties and inadequacies which exist in the present nomenclature in this subject.

Chapter V is, as its title states, a review of the role of the transglycosylation reaction in the formation of oligosaccharides. Its introduction is designed to draw the reader's attention to the growing problem of the function of intracellular hydrolytic enzymes. The reviewer feels that this is particularly timely.

Chapter VI is largely a review of the work carried out in Green's laboratory on the role of metal ions in the reactions catalyzed by flavoprotein enzymes. The chapter contains a great deal of speculation on the detailed role of metals in metabolic process patterns, which the author freely admits requires direct experimental evidence before it can be given much weight.

Chapter VII is a detailed discussion of recent knowledge on xanthine oxidase.

Chapter VIII is a more general discussion of the respiratory chain than that presented in Chapter II. The authors show a commendable tendency to give a definite opinion on controversial aspects of the subject under discussion, where they feel that this is merited, and they do not hesitate to discuss the merits of work from different laboratories bearing on the subject. This causes the chapter to be both informative and very enjoyable to read.

Chapter IX is a very able review of the more recent information on metabolic pathways provided by chemical genetics. This is a great aid in bringing oneself up to date in this important field.

Chapter X is a short and timely discussion of the role of ribonucleic acid in determining the infectiveness of plant viruses.

■■■■■■■■■■

Antibiotics in Nutrition, by Thomas H. Jukes, 128 pp. Medical Encyclopedia, Inc., New York, 1955. Reviewed by IRVIN E. LIENER, University of Minnesota.

In view of the tremendous impact which antibiotics have had in recent years on the animal feed industry, the appearance of this monograph is most timely. A voluminous mass of literature (439 references have been cited) has appeared since 1949 when Dr. Jukes and his colleagues first demonstrated the effectiveness of chlortetracycline in stimulating the growth of chicks. Much of the experimental evidence relating to the role of antibiotics in animal nutrition has been contradictory, so that a critical evaluation of such work is most welcome at this time. This the author has attempted to do in a clear, terse, and easily readable style.

After a brief historical introduction in Chapter 1, Dr. Jukes discusses in Chapter 2 the several mechanisms (as many as ten) which have been proposed to explain the antibiotic growth effects. In Chapter 3 is considered the effect of feeding antibiotics on the requirements of several species of animals for vitamins, minerals, protein, and amino acids. The more practical aspects of the use of

antibiotics in animal production are covered in Chapter 4, where specific consideration is given to poultry, swine, cattle, and sheep. Finally, Chapter 5 is devoted to a detailed description of the physiological and pharmacological effects of antibiotics, particularly on the endocrine system, liver, and blood picture. Although the evidence is still fragmentary and equivocal, the effect of antibiotics on human growth is presented for the benefit of those who are interested in the possible implications of antibiotics in human nutrition.

Unfortunately, numerous typographical and editorial errors have crept into this monograph and have proved to be somewhat disturbing to this reviewer. Several sentences are dismembered in proceeding from page 32 to 33 and from page 33 to 34. No reference is made in the text to Table X on page 41. The reference given for the data presented in Table XI is in error. In the bibliography, the journal *Archives of Biochemistry and Biophysics* has been erroneously cited as *Archives of Biochemistry*. What should be reference 269 in the bibliography is printed as 69. This list is probably not complete but simply represents the most glaring of the errors which will catch the eye of the average interested reader.

■■■■■■■■■■■

The Chemical Constitution of Natural Fats (3rd ed.), by T. P. Hilditch. 664 pp. John Wiley & Sons, New York, 1956. Price, $16.00.

The author supplies a complete account of the constitution of fats, and especially the glycerides, which are produced naturally in plant and animal life. Treating the natural fats as a group of organic chemical compounds, the volume aims primarily at a descriptive presentation, viewed in the light of present knowledge.

Three chapters cover the component acids of fats of aquatic flora and fauna, land animals, and vegetable fats. Dr. Hilditch then studies the component glycerides, including a general survey and separate chapters for individual vegetable and animal fats. A discussion of various aspects of the biosynthesis of fats also occupies a special chapter, followed by one on the constitution of individual natural fatty acids, and another on synthetic glycerides: individual naturally occurring fatty alcohols and acyl ethers of glycerol. In conclusion, the author provides extensive notes on the experimental technique employed in the quantitative investigation of fats. The book takes in the records of approximately 1000 fats.

Dr. Hilbritch is professor emeritus of industrial chemistry, the University of Liverpool.

■■■■■■■■■■■

Methods of Biochemical Analysis, Vol. III, ed. by David Glick. Interscience Publishers Inc., New York, 1956. Reviewed by S. KIRKWOOD, University of Minnesota.

This is the third volume in this well-known series. The titles and authors of the articles give the best brief summary possible of the scope of the book.

I. O. Lindberg and L. Ernster, Determination of organic phosphorus compounds by phosphate analysis.

II. E. L. R. Stokstad, G. R. Seaman, R. J. Davis, and S. H. Hutner, Assay of thioctic acid.

III. C. F. Code and F. C. McIntire, Quantitative determination of histidine.

IV. P. Plesner and H. M. Kalckar, Enzymic micro determinations of uric acid hypoxanthine, adenine, and xanthopterin by ultraviolet spectrophotometry.

V. J. R. Dyer, Use of periodate oxidations in biochemical analysis.

VI. F. Smith and R. Montgomery, End group analysis of polysaccharides.

VII. S. A. Barker, E. J. Bourne, and D. H. Wiffen, Use of infrared analysis in the determination of carbohydrate structure.

VIII. J. Schubert, Measurement of complex ion stability by the use of ion exchange resins.

IX. T. R. Hughes and I. M. Klotz, Analysis of metal-protein complexes.

X. J. Raaflaub, Applications of metal buffers and metal indicators in biochemistry.

XI. Bo G. Malmström, Determination of zinc in biological materials.

XII. M. Margoshes and B. L. Vallee, Flame photometry and spectrophotometry.

This series fills the very definite need for a source to which one can go for a critical evaluation of the various methods of analysis used in biochemical research. In no field of science is progress more dependent upon the rapid application of a wide variety of analytical techniques. Since no biochemist can hope to be thoroughly conversant with the whole field of quantitative analysis, the series undoubtedly saves a great deal of delving into the literature and helps many workers to avoid the not too well-known faults that plague any analytical method.

The present series of chapters appears to the reviewer to be well and, in so far as he is capable of judging, competently written. In each of the chapters there is a great deal of useful information that has application beyond the actual method under discussion. For instance, the sixth chapter will be exceedingly useful to anyone who is contemplating the separation of sugars by modern methods. This volume, like those that preceded it, will be greatly appreciated by biochemists.

■■■■■■■■■■■

The Wheat Industry in Australia, by A. R. Callaghan and A. J. Millington; 467 pages, 287 figures. Angus & Robertson, Sydney, Australia, 1956. Price: 63 shillings Australian. Reviewed by W. F. GEDDES, University of Minnesota.

This book, written by two outstanding authorities on wheat in Australia, deals with the development of the wheat industry, from the first crop in 1789 sown by convicts without the aid of plow or fertilizer, to its present position of importance and stability. The book, however, is not merely a historical survey as it deals with all the problems involved in wheat production including the economic, social, and political ramifications of the industry.

An introduction to the book traces the development of British Agriculture from the exploitative system of two thousand years ago to the permanent agriculture of today. It offers a striking contrast to the young Australian wheat industry.

The book proper comprises 27 chapters which deal with the establishment of agriculture in Australia, rainfall characteristics of the wheat belts, the wheat land soils and their fertility, farming different soil types, milling and baking, wheat bread,

growth of the wheat plant, wheat varieties and their improvement by selection and breeding, wheat diseases, tillage and harvesting implements, bulk handling, world wheat trade and Australian wheat marketing, economics, and the technical advisory services provided the farmer. The chapter on the F.A.Q. system ("fair average quality") gives an excellent description of this marketing standard, the procedure employed in fixing the standard each year, and a discussion of its advantages and disadvantages. A selected bibliography is included. The book is very well illustrated and indexed.

This is a thorough, comprehensive treatise which has been written to give the farmer, agricultural specialists, students, and the general reader detailed knowledge concerning various phases of the Australian wheat industry.

■■■■■■■■■■■

Applied Animal Nutrition, by E. W. Crampton; 478 pp., 15 charts, 86 tables, 28 figures. W. H. Freeman & Co., San Francisco, Calif., 1956. Price, $6.50. Reviewed by J. D. DONKER, University of Minnesota.

The author, a well-known animal nutritionist, presents materials which are designed to facilitate ration formulation. His direct approach to feeding livestock according to principles of nutrition and economics is most commendable. The book is well organized and written, but the context of the material in certain sections may be somewhat difficult for the average university student, who may not be adequately versed in basic subjects before being admitted to production courses using this book. Teachers of nutrition should find it a valuable addition to their shelves, and the book should stimulate the interest of basic nutritionists as well as those interested in problems of feeders. The author has chosen to raise and defend certain points which may be considered rather controversial, e.g., stating that TDN value is a straightforward concept of the digestible energy in a feedstuff rather than a measure of its metabolizable energy.

The first of five sections deals with terminology used in describing and evaluating feeds and in delineating nutritional needs, and discusses the limitations of various schemes of evaluating the several nutritive factors of feedstuffs. Section 2 deals with quantitative requirements of common nutrients for the several species and classes of livestock, along with the development, use, and limitations of feeding standards. Section 3 deals with the characteristics of common feedstuffs. Feedstuffs are grouped in order that substitutions may be made within feed groups. The primary division is between roughages and concentrates, each of which is divided according to protein content. Emphasis is on most efficient utilization of the grain supply. In this section are discussed the uses of special supplements, such as amino acids, vitamins, minerals, and certain other miscellaneous items.

The fourth section brings together materials from the preceding ones to develop ration formulation. The mechanics of utilizing feed standards is given in detail, with special emphasis on flexible formulation.

The text is concluded with three appendices which contain rules-of-thumb for feeding, information regarding feed legislation and legal description of feedstuffs, and a section on feedstuff analysis that includes many examples of commonly used roughages and concentrates.

Apparently there is a minor error in Table 18-1, in which there is listed under "Recommended formula" an excess of 30 lb. of "30-45% protein" and a shortage of 30 lb. of "basal feeds."

A more serious criticism may be leveled at the discussion which follows Table 15-3, which sets forth the requirements of protein content of concentrates used for milking cows when roughages are used. Although the author's ideas are clear, certain isolated statements could completely negate his specific aim because they do not carry built-in qualifications. Such statements as "This result shows that for larger production, slightly less protein is required in the meal mixture" and "This result would lead to the conclusion that as larger cows are involved a slightly higher percentage of protein will be needed" could be seriously misleading to students who often seize upon isolated statements as statements of fact. The comments which qualify these remarks as being dependent upon a certain percentage of protein in the roughage consumed are rather far removed from the statements in question. Although a cow which is giving 50 lb. of milk daily in the last two months of gestation may be useful for purposes of illustrating nutrient need, lactation needs do not generally compete seriously with the growing fetus, as the animal should be dried off 5 to 6 weeks before calving.

■■■■■■■■■■■

The quarterly botanical review *Materiae vegetabiles* began publication in 1952 as the organ of the International Commission for Plant Raw Materials. According to the introduction in Vol. I, No .1, it is dedicated to the whole domain of vegetable raw materials, a needed "connecting link" for the botanist or cultivator who "has not always sufficiently understood the potential use-value of plant raw materials" and the consumer who lacked knowledge of their origin and therefore was unaware of the methods of improving and perfecting his material.

Issues average about 100 pages of articles plus "notes, reviews, personalia, and book reviews." Articles are in various langauges (English, German, French), each with a summary in one other language. The journal is printed at Uitgeverij Dr. W. Junk, The Hague, Netherlands, and edited by C. Regel and F. Tobler. Manuscripts are to be sent to the latter: Prof. Dr. F. Tobler, Schopfacker, Trogen (App.), Switzerland.

Wheat in Kansas

(Continued from page 77)

10. KYRK, HAZEL. Food Research Institute, Misc. Publ. No. 2. Stanford Univ. Press (1925).
11. LARMOUR, R. K. The effect of environment on wheat quality: A resume. *Trans. Kansas Acad. Sci. 42:* 81–89 (1939).
12. MALIN, J. C. Winter wheat in the golden belt of Kansas. Univ. Kansas Press: Lawrence, Kansas (1944).
13. MYERS, H. E. Soil quality and wheat quality. *Milling Production 11* (12): 8 (Dec. 1946).
14. POOL, J. R. Marching with the grasses. Univ. Nebraska Press: Lincoln (1948).
15. REITZ, L. P. Wheat breeding and our food supply. *Econ. Bot. 8:* 251–268 (1954).
16. SALMON, S. D., MATHEWS, O. R., and LEUKEL, R. W. A half century of wheat improvement in the United States. Advances in Agronomy Vol. 5, pp. 1–151 (1953).
17. SHELLENBERGER, J. A., JOHNSON, J. A., LAUDE, H. H., PALMER, D. H., and MILLER, G. D. Milling and baking characteristics of Kansas wheat. Kans. Agr. Exp. Sta. Circ. 303 (1954).

A.A.C.C.

LOCAL SECTIONS

Following a dinner at the Poodle Dog Restaurant, San Francisco, the Northern California Section heard Dr. S. I. Taimuty, nuclear physicist of Stanford Research Institute, discuss "Nuclear magnetic resonance," a new analytical tool that is being applied to moisture determination. Dr. Taimuty explains its principles and techniques and how they are applied to the analysis of liquid systems containing hydrogen, fluorine, and other elements.

• • • •

U. S. wheat standards were again discussed by AACC President Lawrence Zeleny at the Midwest Section's March meeting, on the 4th. After touching briefly on the background, history, and structure of the wheat standards, Dr. Zeleny spoke in more detail on standards now under consideration, and on lines of research aimed at eventual further improvement of the standards. After bringing the members up to date on current Association affairs, Dr. Zeleny presented the Section with a Certificate of Recognition.

The annual luncheon was held on March 6, in connection with the Bakery Engineers' meetings held at the Edgewater Beach Hotel.

In February the scheduled speaker, Mr. Albert V.

KEL-PAK

powders

Speed Kjeldahl digestions with Kel-Pak Powders.

The powders are complete precision blends of nitrogen-testing chemicals of fine quality. Ready to use, they are packaged in inert, foam reducing, airtight polyethylene bags.

These powders permit you to run Kjeldahl determinations with greater precision, at a great saving of time.

The powders conform to the standard methods of the A. O. A. C.

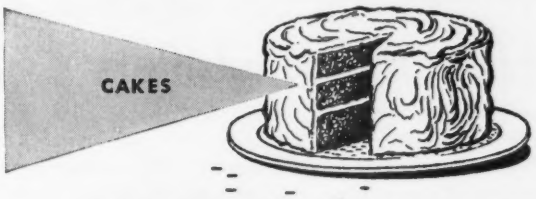
Five standard formulas are available.

They are packed in boxes of 1000 packets. The minimum shipment is 500 packets. They are not mailable.

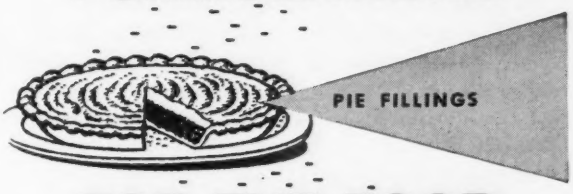
KANSAS CITY
Laboratory Supply Co.

307 Westport Road Kansas City 11, Missouri
Telephone JEfferson 1-7745

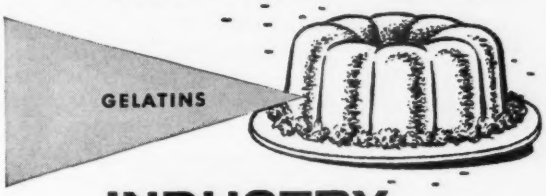
FINE FLAVOR



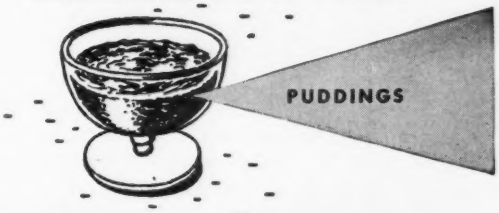
FORMULATIONS



FOR THE FOOD



INDUSTRY.....



FRIES & FRIES

flavors

Developing new and distinctive flavors or supplying established ones are equally important at Fries and Fries.

Our modern flavor laboratories are staffed with highly skilled chemists and technicians who have helped perfect the flavorings of many fine products found on every supermarket shelf.

Your inquiry will be given prompt attention and treated in strict confidence.

MANUFACTURING CHEMISTS
FRIES & FRIES
INC
CINCINNATI
U.S.A.

NEW YORK • 418 E. 91st St. • SA 2-2260
CINCINNATI • 110 E. 70th St. • VA 1-7200

Competition and food emulsifiers

Ever since the day two men started offering the same food product in the same market place, the food manufacturer has had to make a choice—either say his wares cost more because they are better, or find a way to make them better and yet cost the same or less. More businesses have been built on the latter than the former.

The hundreds of tons of monoglyceride emulsifiers that have come from our plant have done a bit to solve this competitive dilemma. For *Myverol Distilled Monoglycerides* happily cost less than the usual mono-diglyceride reaction mixtures, when measured on the scale of emulsifying effectiveness. The scales tip even further when you add the production economies they often help achieve.

Now about product quality. Here are two examples of what you can expect.

In peanut butter, experience with one type of *Myverol* has shown that it will not only stabilize and protect against "oil out" but will also confer the bonus benefits of 1) less stickiness in the mouth and 2) a very wide temperature range for the consistency that consumers like.

Or take household shortenings. With *Myverol*, shortenings can be produced that make a smooth cake batter of the right consistency, one that bakes to superior volume with controlled porosity.

And so on. Since *Myverol Distilled Monoglycerides* come in several forms, made from a choice of fats and oils, it is possible to select the emulsifier that is exactly right for the effect sought in your product.

The best way to find out how much you can save with Myverol Distilled Monoglycerides, how Myverol can improve your products, is simply to try it. To get under way, write ***Distillation Products Industries,*** Rochester 3, N. Y. Sales offices: New York, Chicago, and Memphis • Gillies Inc., Los Angeles, Portland, and San Francisco • Charles Albert Smith Limited, Montreal and Toronto.

distillers of monoglycerides made from natural fats and oils

Also . . . vitamin A in bulk for foods and pharmaceuticals

DPi

Distillation Products Industries
is a division of **Eastman Kodak Company**

Grundy of the Quartermaster Food & Container Institute, was unable to appear and Mr. George Tripp of the Institute stepped into the breach with a good talk.

• • • •

Lone Star Section's spring meeting on March 9, held at the Huckins Hotel in Oklahoma City, Oklahoma, had two sessions and a group luncheon. Speaker for the morning session was Ed Granstaff of Oklahoma Crop Improvement Association, A & M College, Stillwater; his subject, "Oklahoma's pure seed increase program and its importance to the wheat industry." In the afternoon J. L. Spaulding, manager of the Quaker Oats Company's laboratory at St. Joseph, Missouri, addressed the group on "Testing for extraneous materials in cereal foods," and a discussion period followed.

• • • •

The Niagara Frontier Section held its March meeting at the Erie County Institute on the 11th. Mr. C. O. Gourley of Beacon Milling Co. showed a film on "Feed Research and Feeding Practices." Following the movie he talked on feed operations at his Cayuga plant.

• • • •

New York Section was host on February 11 to Lawrence Zeleny on one of his presidential visits, to acquaint members with Association affairs and discuss matters on which he is so well qualified to speak, particularly on this occasion, U. S. wheat standards. Among recommendations and proposals he outlined are: a 13.5% moisture limit for all grades; a separate grade for wheats with low moisture levels; reduced tolerances for foreign materials and shrunken and broken kernels; and specific sanitation measures. The "test weight per bushel" requirement will be unchanged, Dr. Zeleny said, because this correlates, to some extent, with flour yield. He emphasized, however, that these changes are still under study and nothing definite has been decided.

Present research is partly concerned with developing practical and rapid tests to reflect over-all baking strength. A fat acidity determination used in grain inspection procedures, made in 7 minutes, was described. Dr. Zeleny also reviewed recent developments in the sedimentation test for wheat quality.

• • • •

The Chesapeake Section of the A.A.C.C. met February 28 at the Agricultural Research Center, Beltsville, Maryland. The after dinner speaker was William Horowitz of the U.S. Food and Drug Administration who gave an informative talk on the organization and function of the American Association of Official Agricultural Chemists.

The next meeting of the group was held on March 28 at Marty's restaurant in Baltimore, Maryland. Raymond T. Bohn from Bohn Food Research, Inc., talked on "The Fate of Sugar in Yeast Raised Products."

The April meeting will be held on the 25th, at the Agricultural Research Center, Beltsville. Floyd Hosking of Corn Products Industries Research Foundation will speak on "Use of Corn Products in Bakery Goods."

• • • •

The Nebraska Section held their March meeting on the 16th at University of Nebraska, Lincoln. Gerald Reed of Red Star Yeast & Products Co. talked on "Enzymes from Microbiological Sources in the Cereal Industry." "New Developments in Feed and Animal Nutrition" was presented by G. P. Whitlock, National Dairy Council, Chicago.

Instructions to Authors

General. Authors should submit two copies of the manuscript, typed double-spaced with wide margins on 8½ by 11-inch white paper. Either original drawings or glossy photographs may be submitted for figures; photographs of equipment, etc., requiring halftone engravings should have good contrast and be printed on stock approximately 5 by 7 inches or larger.

Editorial Style. A.A.C.C. publications are edited in accordance with *A Manual of Style*, University of Chicago Press, and *Webster's Dictionary*. A few points which authors often treat wrongly are listed below:

Use names, not formulas, for text references to chemical compounds. Use plural verbs with quantities (6.9 g. were). Figures are used before unit abbreviations (3 ml.), and % rather than "per cent" is used following figures. All units are abbreviated and followed by periods, except units of time, which are spelled out. Repeat the degree sign (5°–10°C.) but not the % sign (45–50%). Place 0 before the decimal point for correlation coefficients ($r = 0.95$). Use * to mark statistics that exceed the 5% level and ** for those that exceed the 1% level. Type fractions on one line if possible, e.g., $A/(B+C)$. Use lower case for farinograph, mixograph, etc., unless used with a proper name, i.e., Brabender Farinograph. In text, spell out numbers 1 through 10 (except before unit abbreviations); use numerals for those above 10. For microgram the symbol γ is preferable to μg; for millimicrogram, $m\gamma$. Do not use ditto marks. Do not use the symbol # for either "number" or "pounds." Be watchful to avoid using a plural verb with a singular noun and vice versa. Technical writing usually demands the use of the impersonal form; "we," "I," "our," etc., are rarely used. When in doubt about a point that occurs frequently, consult the Style Manual or the Dictionary.

Length. The proper length of a technical article depends largely upon the extent and complexity of the work being reported and thus no specific word range can be given. However, a brief but concise report will command more interest than a rambling one, and thus authors are urged to limit their papers accordingly.

Tables. Data should be arranged to facilitate the comparisons readers will make. Tables should be kept small; large ones may be broken up if this is feasible. A table limited to six or seven tabular columns is an ideal maximum, although larger ones can be accommodated. Authors should omit all unessential data such as laboratory numbers, columns of data that show no significant variation, and any data not discussed in the text. A text explanation can frequently be substituted for columns containing only a few data. The number of significant figures should be minimized. Box and side headings should be kept short by abbreviating freely; unorthodox abbreviations may be explained in footnotes, but unnecessary footnotes should be avoided. Leader tables without a number, main heading, or ruled lines are often useful for small groups of data.

Tables that are wide and short, i.e., having many columns and few side headings, can sometimes be reversed to fit the page better. If clarity is not sacrificed, such an arrangement is preferable and may even be an improvement.

Tables should be typed on separate pages at the end of the manuscript and their position should be indicated to the editor by typing (Table I Here) in the appropriate place between lines of the text. (Figures are treated in the same way.)

Figures. If possible, all line drawings should be made by a competent draftsman. Traditional layouts should be followed: the horizontal axis should be used for the independent variable; curves should be drawn heaviest, axes or frame intermediate, and the grid lines lightest; and experimental points should be shown. Labels are preferable to legends. Authors should avoid identification in cut-lines to be printed below the figure, especially if symbols are used that cannot readily be set in type.

All drawings should be made about two to three times eventual reduced size, with India ink on white paper, tracing linen, or *blue*-lined graph paper; with any other color, the unsightly mass of small grid lines is reproduced in the cut. Lettering should be done with a guide, using India ink; and letters should be drawn in proportionate sizes to reproduce 1/16 to 1/8 inch high after reduction.

Cut-lines (legends) should be typed on a separate sheet at the end of the manuscript. "Preparation of Illustrations and Tables" (Trans. Am. Assoc. Cereal Chemists **3**: 69–104. 1945) amplifies these notes.

Summary. A concise summarizing paragraph of 200 words or less is encouraged though not required. It should state the principal results and conclusions.

Literature. In general, only recent papers need be listed. Citations are listed alphabetically and then numbered. Each should show author, journal, volume, first page, and year. Reference numbers must invariably be cited in the text, but authors' names and year may be cited also. Abbreviations for the names of journals follow the list given in *Chemical Abstracts* **45**: vii–cclv (1951).

Text. Clarity and conciseness are the prime essentials of a good technical paper. Subject matter must be organized in a logical manner that aids the reader's comprehension. The frequent use of good headings and the skillful handling of topic sentences are the greatest aids to clarity. While technical articles are written for the chemist, they need not be as formal as those appearing in purely research journals. Considerable help in manuscript preparation may be obtained from the article, "On Writing Scientific Papers for Cereal Chemistry" (Trans. Am. Assoc. Cereal Chemists 6: 1–22. 1948).

Observations

Because our custom mixing operation in our former location was so popular with the milling and feed chemists we are installing mixing equipment at our new laboratory. Our new mixing facilities are the ultimate in blending all type trace materials. We anticipate this equipment will be used primarily in the feed field; however, we will be in a position to do mixing for our customers on just about any type of material.

It occurred to us that some of the cereal chemists might have some problems that our mixing equipment could solve for them. We will be able to handle trace materials in any quantity from 100 to 4000 pounds in single batch operation. Of particular interest is the fact that our rotary 4000 pound mixer will handle materials of different specific gravity and still obtain very good dispersion of all materials. The operation will be more or less automatic and we will be able to package in multiwall paper bags from 10 to 100 pounds as well as package in fiber drums.

With the advent of new drugs in feeds and the demand for accurate assays of all such pre-mixes by the Food and Drug department we anticipate that we will be able to be of genuine service to some of the feed mixers. With our vitamin assay laboratories, we will also be in a position to do vitamin pre-mixes along with the usual trace mineral pre-mixes to customers specifications at a low cost.

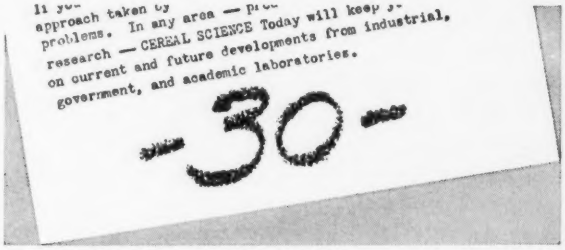
If any new mixing problems should arise wherein you think we might be of service in working out procedures, we will appreciate your inquiry. Furthermore if we can mix for you on a regular contract basis we will appreciate your consideration.

We are looking forward with a great deal of pleasure to seeing all of our friends in San Francisco next month.

Jim Doty

DOTY
Technical Laboratories

1435 Clay St.,
North Kansas City 16, Mo.
MILLING FEED ANALYSIS
VITAMIN ASSAYS
BAKING SANITATION


research — CEREAL SCIENCE Today will keep
on current and future developments from industrial,
government, and academic laboratories.
-30-

U. S. Wheat Standards Revised

The following bulletin was received from the Millers' National Federation shortly before press time. Its contents merit close consideration by all chemists in the cereal industry.

★ ★ ★

The USDA has announced a number of revisions of the official grain standards for wheat.

The revisions will become effective June 15, 1957. Full details of the revisions appear in the Federal Register of March 15, 1957. However, in its announcement the Department indicated in general terms the revisions which have been made.

These changes are as follows:

1. A reduction in the limits of total foreign material to 0.5%, 1.0%, 2.0% and 3.0% in grades 1, 2, 3, and 4, respectively, compared with 1.0%, 2.0%, 3.0%, and 5.0% now permitted. The factor, "matter except other grains" is eliminated.
2. A reduction in shrunken and broken kernels in Nos. 1 and 2 to 5.0% and in No. 3 to 8.0%. Present tolerances are 7.0% for Nos. 1 and 2 and 10% for No. 3.
3. A reduction in the limits of wheats of other classes in No. 2 grade to 5.0%. Present tolerances are 5.0%, 10%, and 10% for grades Nos. 1, 2 and 3, respectively.
4. An increase in the minimum limits of dark, hard, and vitreous kernels in the subclass Hard Winter Wheat from "more than 25%" to 40%.
5. The elimination of "Amber Mixed Durum" and "Mixed Durum" from the grade designation in the class Mixed Wheat; and
6. A provision that distinctly low quality be determined on the basis of the sample as a whole, that is, before the removal of dockage.

The foregoing revisions follow in practically all respects the proposals which were considered at the public hearings held in January.

Undoubtedly, these changes will have the effect of improving the quality of wheat represented by the U. S. grades. However, it is to be expected that the milling industry will be disappointed that these revisions do not include three additional changes which were advocated by the milling industry and which the industry felt were of great importance.

The Department's announcement referred to these three proposals as follows:

"No change is made in the method of expressing dockage, which will continue to be in terms of whole percents; and in the present method of evaluating smutty wheat.

"The limits of moisture for the special grade 'tough wheat' are unchanged for all classes.

"The definition of 'sample grade' remains unchanged with no reference to 'contamination by animal filth'. Wheat which is distinctly contaminated will continue to be interpreted as 'distinctly low quality' as in the past, with emphasis on uniform interpretation and application."

Convention Highlights

On page 81 of this issue readers will find a resumé of the AACC's Technical Program and an introduction to the guest speakers. In addition, AACC members have just received in the mail a convention packet containing information pertinent to their full enjoyment of the meeting. May we suggest that the hotel reservation card be returned *promptly*.